DESIGN, CONSTRUCTION, OPERATION OF METAL-WORKING AND ALLIED EQUIPMENT

MACHINERY

NOVEMBER, 1942

A detailed description of the methods of making a world-famous automatic pistol—the Colt automatic—will be published as the leading feature in December MACHINERY. Other important articles in the same number will cover the methods used for keeping arc welder sets in first-class condition to meet the requirements of the war industries; conservation of metals and materials of which there is a serious scarcity; reconditioning of milling cutters, both for the purpose of conserving steel and for reasons of economy; and the successful employment of women in war industries. Another subject of especial interest to be dealt with in this number is the flame-cutting of sprocket teeth.

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MACHINERY

Volume 49 NEW YORK, NOVEMBER, 1942 Number 3

SHIPYARDS AND INDUSTRIAL PLANTS CONTRIBUTING TO AMERICA'S PHENOMENAL SHIPBUILDING ACCOMPLISHMENTS ARE FEATURED IN THIS ISSUE OF MACHINERY, PUBLISHED WITH THE COOPERATION OF THE UNITED STATES MARITIME COMMISSION

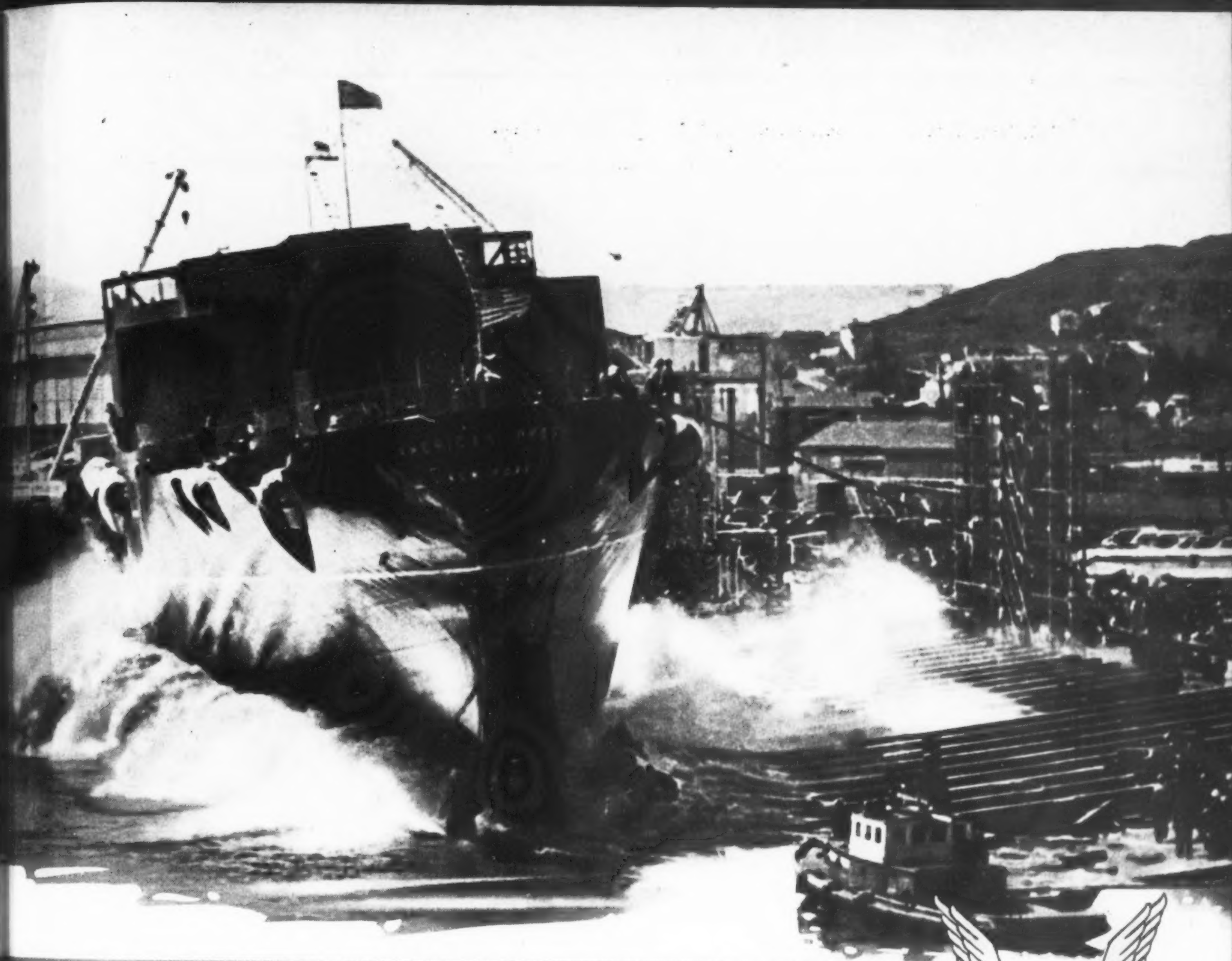
★ REAR ADMIRAL HOWARD L. VICKERY (U.S.N.) ★

Merchant Ships for Victory

THE events of this year must by now have convinced the nation that our two oceans in and of themselves do not protect us. It must be clear that they are highways, not barriers. Our shipping, our use of those highways, is an assurance that they will not be used against us. The merchant marine of the United Nations is holding on grimly, depending upon the reinforcements being supplied by the shipyards of America.

To meet the almost limitless demands of this war of immense distances, the United States Maritime Commission has launched the greatest shipbuilding program the world has ever seen. Our goal is some 2300 new ships of 24,000,000 tons deadweight by the end of 1943. It is an enormous undertaking. But with the last twelve months' achievement as our yardstick, it can be fulfilled. Only a shortage of materials—not a lack of capacity—will prevent it.

In the twelve months preceding October 1, 486 new ships were delivered by American shipyards into the war service of the United Nations. Of that number, 313 were Liberty ships, the remainder tankers and standard design vessels. Only 29 of the total number were delivered



By REAR ADMIRAL HOWARD L. VICKERY (U.S.N.)
Vice-Chairman, United States Maritime Commission and
Deputy Administrator, War Shipping Administration

in the last three months of 1941; the others have come with ever increasing speed from our yards since January 1 of this year.

In April, 1942, we began delivering one ship a day; in June, two. In September, we reached the rate of three ships a day. This was two months ahead of the time set in the Commission's most optimistic estimates of a few months

ago. Deliveries by months thus far in 1942 demonstrate our ever expanding building capacity and our accelerated production effort. In January, sixteen merchant ships were delivered into service; in February, twenty-six; in March, twenty-six; in April, thirty-six; in May, fifty-seven; in June, sixty-seven; in July, seventy-one; in August, sixty-eight. In September, we topped our goal with ninety-three ships, three more than the anticipated three a day.

With these deliveries, the 1942 production has passed the 5,000,000-ton mark. By the end of the year, Maritime Commission schedules call for the delivery of at least 3,000,000 additional tons. Thus will be attained the 8,000,000-ton goal set by the President in his directive issued in January.

Of the more than 2300 merchant vessels scheduled for production in 1942 and 1943, about 1400 are of the emergency cargo, or Liberty ship, type. More than 300 are tankers, and the remainder are of standard C-type and other advanced designs. Besides these large ocean-going vessels, the building program calls for the delivery by the end of 1943 of nearly 1000 smaller craft of various types. The latter are not included in the 24,000,000-ton objective.

While our shipbuilding achievements to date represent the sum of the efforts of all the shipyards, the individual accomplishments of certain ones are particularly noteworthy. The Oregon Shipbuilding Corporation at Portland, for example, has delivered more Liberty ships than any other yard. Recently, two larger yards, the California Shipbuilding Corporation at Wilmington and the Bethlehem-Fairfield Shipyard, Inc., at Baltimore, have vied for first place in the total number of ships delivered per month. The Oregon Shipbuilding Corporation, however, continues to lead all other yards with the greatest productivity per way.

The most spectacular accomplishment of American shipbuilders this past year has been the reduction in building time for the Liberty

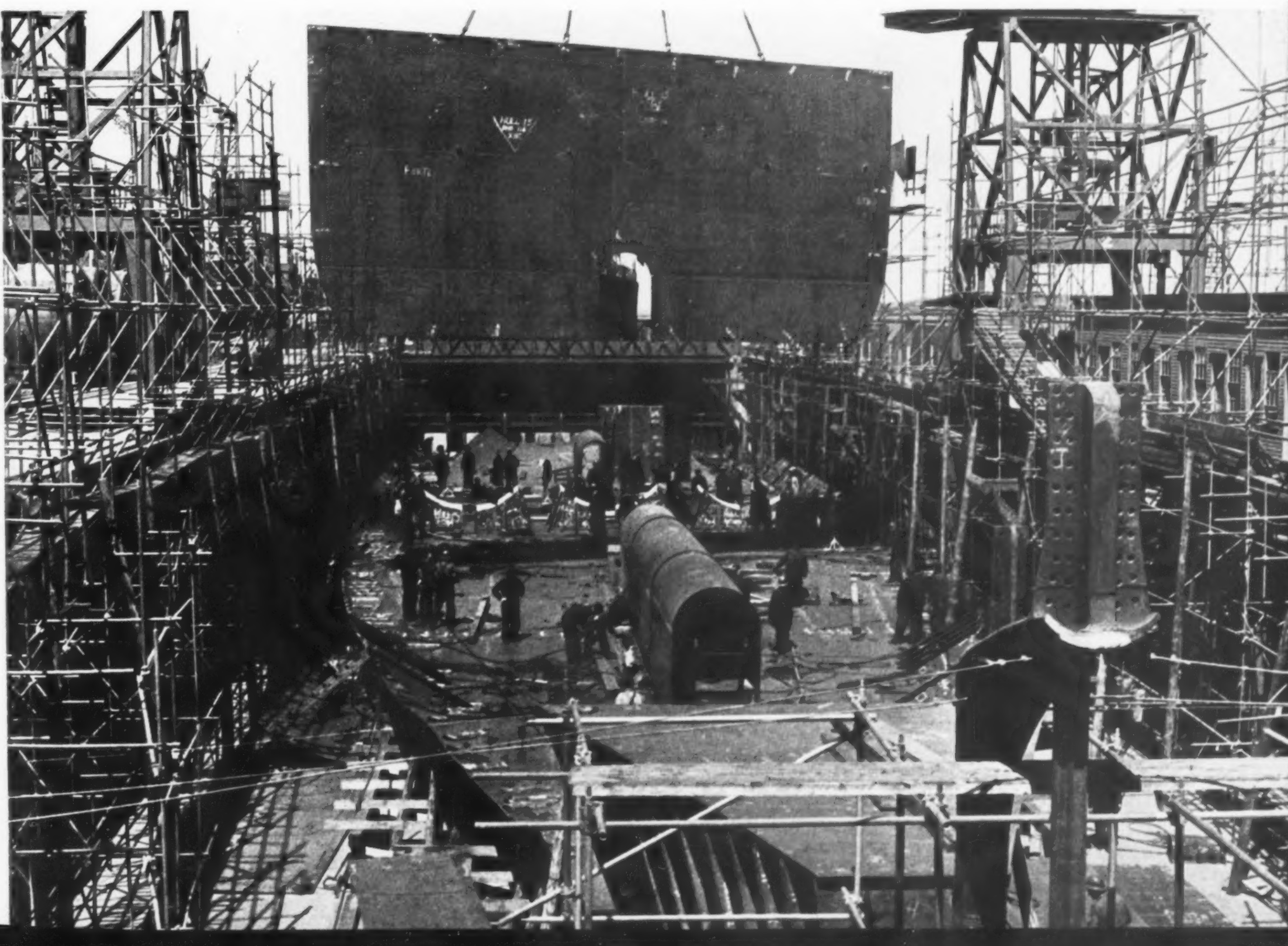
Fig. 1. Aerial View of a Busy Shipyard on the West Coast, which Shows a Large Number of Fabricating Platforms from which the Welded Structures are Transferred Immediately to the Shipways Seen at the Right

ship. In January, the average time from keel-laying to delivery was 241.3 days; by July this had been cut to 108.4 days, a reduction of more than 50 per cent. By September, the average building time had been reduced to 70.1 days. At the time of writing, the Oregon Shipbuilding Corporation holds the record for Liberty ship construction with a September average of 42 days from keel-laying to delivery for the eleven ships delivered during that month.

Already the Liberty ship—our mass-production emergency cargo vessel — has more than justified the authorizations made by the Maritime Commission to build 1400 of them by the end of 1943. Scores of them are veterans now, and their logs speak for themselves. The *Patrick Henry,* on an early voyage, steamed a distance of 7633 miles at an average speed of 11.6 knots. For most of the trip she carried a useful load of 11,028 long tons and, after discharging a small part of her cargo, proceeded with a useful load of 10,898 tons. Oil consumption varied from 193 to 194 barrels per day. Checked against the logs of the *Artigas* and the *Cold Harbor*—ships of somewhat similar design and power built at Hog Island in 1920—the sea performance of the *Patrick Henry* far outstripped the other two. With a cargo greater by 1400 to 3500 tons than her predecessors, she attained a speed of from one to three knots faster under comparable sea conditions, with a marked superiority in fuel economy.

The Liberty ship meets the three most urgent needs of the wartime emergency: It can be built with unprecedented rapidity; it can be operated simply; and its cost is reasonable. Because the Commission could not obtain turbine drives for its vast emergency fleet without interrupting the progress of its long-range shipbuilding program, it resorted to a more readily manufactured type of propulsion machinery. Adoption of triple-expansion reciprocating steam engines in the construction of Liberty ships had made it possible to utilize the services of many of the

Fig. 2. Ship Production for the Program of the United States Maritime Commission will Total Approximately Eight Million Tons in 1942—the Goal Set by the President in His Directive of Last January



country's untapped manufacturing facilities, and thus prevent a production bottleneck. In the shipyards, extensive use of welding saves both time and steel. The modification of fabrication methods permits greater utilization of unit assembly methods. To expedite procurement, materials and equipment for all of these ships are being obtained through the Commission's own centralized purchasing organization.

Formerly an indigenous coastal industry, shipbuilding today is a nation-wide undertaking. Now, in inland towns and cities, men who have never seen the sea are producing materials, equipment, and accessories for our merchant fleet. More than seven hundred manufacturing plants in this country are at work on Maritime Commission contracts.

To appreciate fully the scope of the shipbuilding program the Maritime Commission has projected, it must be viewed against the backdrop of the past two-score years. Following the last World War, America became "sea poor." Numerous shipyards were idle, and in the rivers and harbors along our coasts lay the hulls of half finished vessels, abandoned after peace was made, to rust or rot away. In the fifteen-year period between 1922 and 1937, American shipyards built only two ocean-going dry cargo vessels. When the Maritime Commission was created in 1936, there were but 10 shipyards with 46 ways capable of producing ocean-going vessels 400 feet or more in length. About half of those ways were occupied with Naval construction and many of the others were idle.

One of the primary purposes for which the Maritime Commission was established was to devise and execute plans to construct new merchant ships to replace the worn and obsolete vessels operating in the American Merchant Marine. Practically all of the ships under the American flag had been constructed prior to 1922, and most of them were either nearing the end of their normal twenty-year term of efficient service or had even passed that stage.

Late in 1937, the Maritime Commission's initial program to construct fifty ships a year over a ten-year period was projected. Fortunate it was that this modest beginning had been made

Fig. 3. The Members of the United States Maritime Commission (Left to Right) Commissioner Thomas M. Woodward; Rear Admiral Howard L. Vickery, Vice-chairman; Rear Admiral Emory S. Land, Chairman; Captain Edward Macauley; and Commissioner John M. Carmody

before the Nazis began to march, for it served as a springboard from which we could plunge into the production of an armada of merchant vessels such as no nation ever before contemplated.

But all the ships we are building would be useless without crews. Recruitment of personnel to man the rapidly expanding fleet is a vital consideration in the present program of the Maritime Commission and the War Shipping Administration. More than a hundred thousand additional officers and men will be needed by the end of 1943 to take the 2300 new ships to sea. Already there is a general shortage of deck officers and engineers, as well as acute local shortages of seamen, firemen, radio operators, and other seagoing personnel. The men being turned out by the War Shipping Administration's training schools will not begin to meet the need for some time to come. The present demand can be met only by the return to sea of the skilled licensed and unlicensed seafaring men now ashore. The nation's need for their services on shipboard is urgent.

To indulge in crystal gazing in the face of the harsh realities of the present world picture is folly. However, the speed with which the Maritime Commission's program is being fulfilled does hold out, along with the mounting production of tanks, planes, and guns, a reassuring promise of victory. Those who have the courage to look beyond the dark horizon of the present see in the long-range program vessels which, with the Liberty ships, are coming off the ways of American yards today, the nucleus of a post-war American Merchant Marine second to none. When the freedom of the seas has once more been guaranteed, these fast, competitively superior C-type vessels will ply ocean trade routes with full cargoes for new world markets.

Just as our ships today are carrying to our allies the materials of war, so in the future will they carry the materials of peace. American commerce transported in the bottoms of American vessels will in a large measure help to reestablish prosperity and order throughout the post-war world.

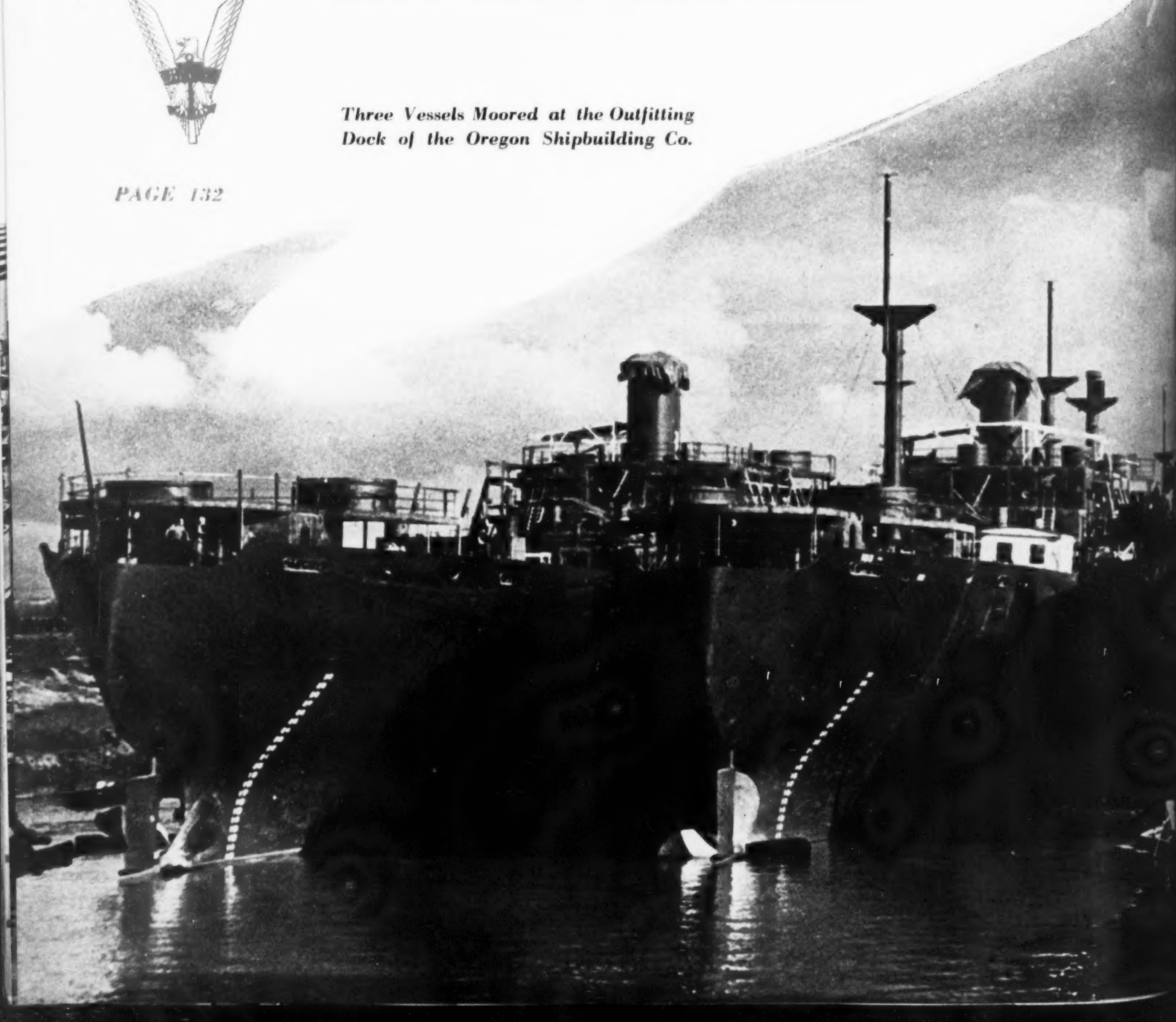
Fig. 4. Shipyards Operate on the Basis of Twenty-four Hours a Day, Seven Days a Week. This Photograph, Taken in a West Coast Shipyard, Shows Three Shipways in the Dead of Night on which Liberty Vessels are Ready for Launching to Join Our Rapidly Growing Cargo Fleet

Why Kaiser is the World's Number One Shipbuilder

The Oregon Shipbuilding Co. (One of Kaiser's Yards) Holds the Speed Record for Building 10,000-Ton Liberty Ships—Only Ten Days from the Laying of the Keel to Launching Date and Three Days More to Delivery. This Article Outlines how Such Record-Breaking Performance is Achieved

By CHARLES O. HERB

Approved for Publication by the U. S. Maritime Commission



Three Vessels Moored at the Outfitting Dock of the Oregon Shipbuilding Co.

The Incredible HENRY J. KAISER—
Number One Shipbuilder of the World

Why Kaiser is the World's

THE entire nation has been electrified by the miraculous success of Henry J. Kaiser, noted Pacific Coast contractor, in building merchant vessels to meet the urgent needs of the United States and its Allies. Unbelievable records have been established — in September, a Liberty ship was launched within only ten days after the keel was laid, more than 87 per cent complete. Three days later it was delivered. By October 1, Kaiser yards alone had delivered 147 fully completed Liberty ships, as well as other types of ships. In addition, yards in which Kaiser has interests, delivered 68 Liberty ships.

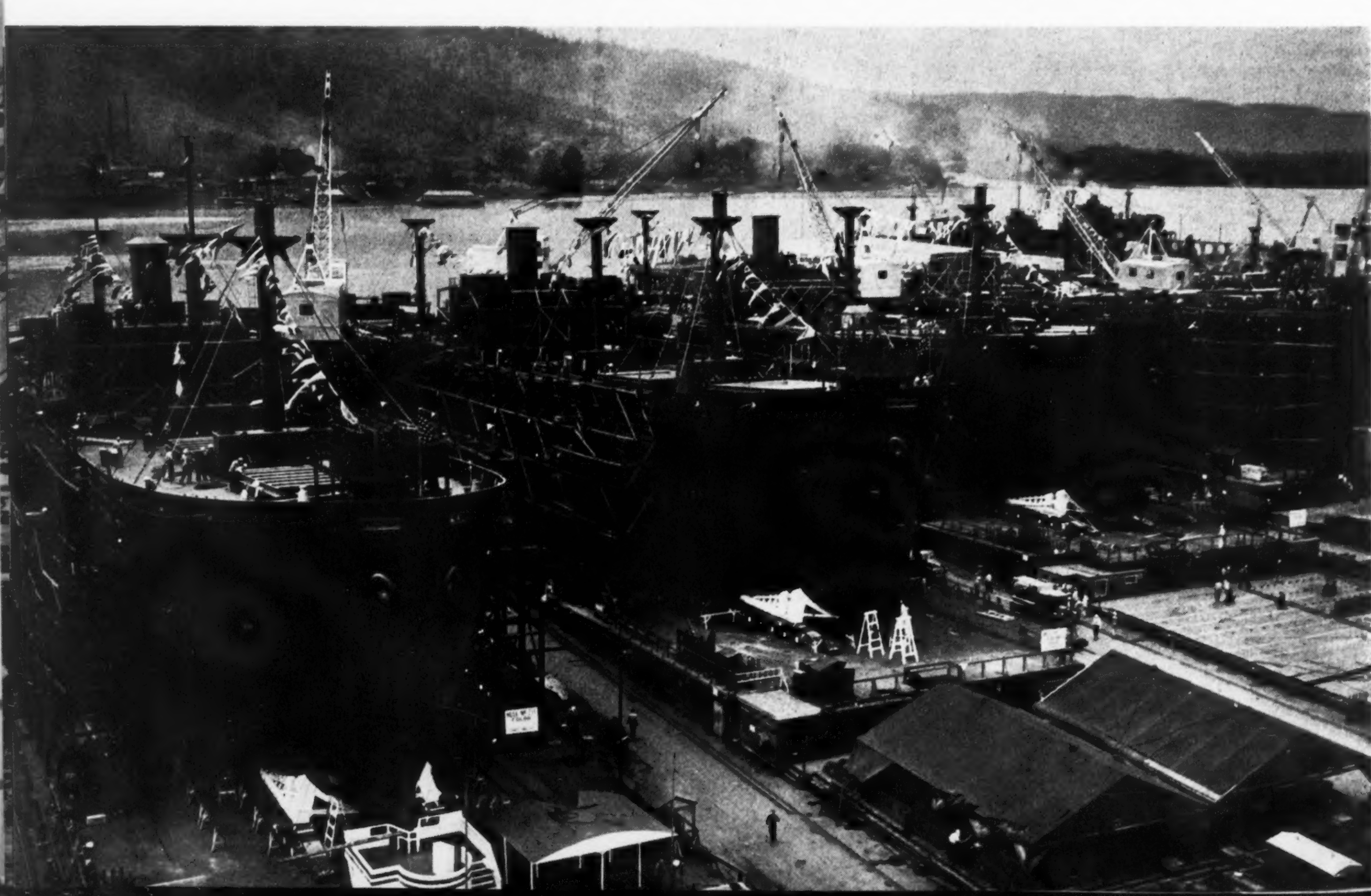
Kaiser's achievements have been all the more spectacular because he had no experience in shipbuilding up to less than two years ago, and because many of the men who are operating his shipyards have never seen any other shipbuilding operations than those going on under their supervision. It is amazing, then, that Kaiser's shipyards are launching and outfitting large cargo vessels in less than one-half the time necessary to receive the Maritime Commission's Award of Merit, which is emblematic of excellent performance.

What is the secret formula of Kaiser's success in a project that, offhand, seems quite remote from that of dam-building for, as almost everyone knows, Kaiser first achieved fame as the builder of the Bonneville, Grand Coulee, Boulder, and Shasta Dams. Kaiser men will tell you that it is no secret—merely the tackling of a huge job by an organization of men experienced in doing things in a big way and who, because of having no previous knowledge of shipbuilding, were free to plan production methods without any preconceived or biased opinions as to how the work should be done.

Kaiser methods are based on prefabricated construction of ship sub-assemblies and assemblies in the shops and in the shipyards, which minimizes the work required on the ships themselves. Huge inner bottoms, bulkheads, deckhouses, hatches, and so on are brought to the shipways completely assembled, so that the only welding and riveting performed aboard ship is that required to attach these assemblies.

Prefabrication is, therefore, the fundamental principle of the program carried out in the seven Kaiser yards, all of which are located on the Pacific Coast, three in the vicinity of Portland,

Fig. 1. The Eleven Shipways of the Oregon Shipbuilding Co. are Beehives of Activity. The Vessels are Almost Entirely Constructed from Prefabricated Units



Number One Shipbuilder

Oregon, three around San Francisco, and one in the environs of Los Angeles. Because the yard of the Oregon Shipbuilding Co. at Portland holds the record for the completion of Liberty vessels in the shortest time, that yard was selected as the most worthy of description in this article. Up until October 1, this yard alone had built seventy-six vessels—in one year.

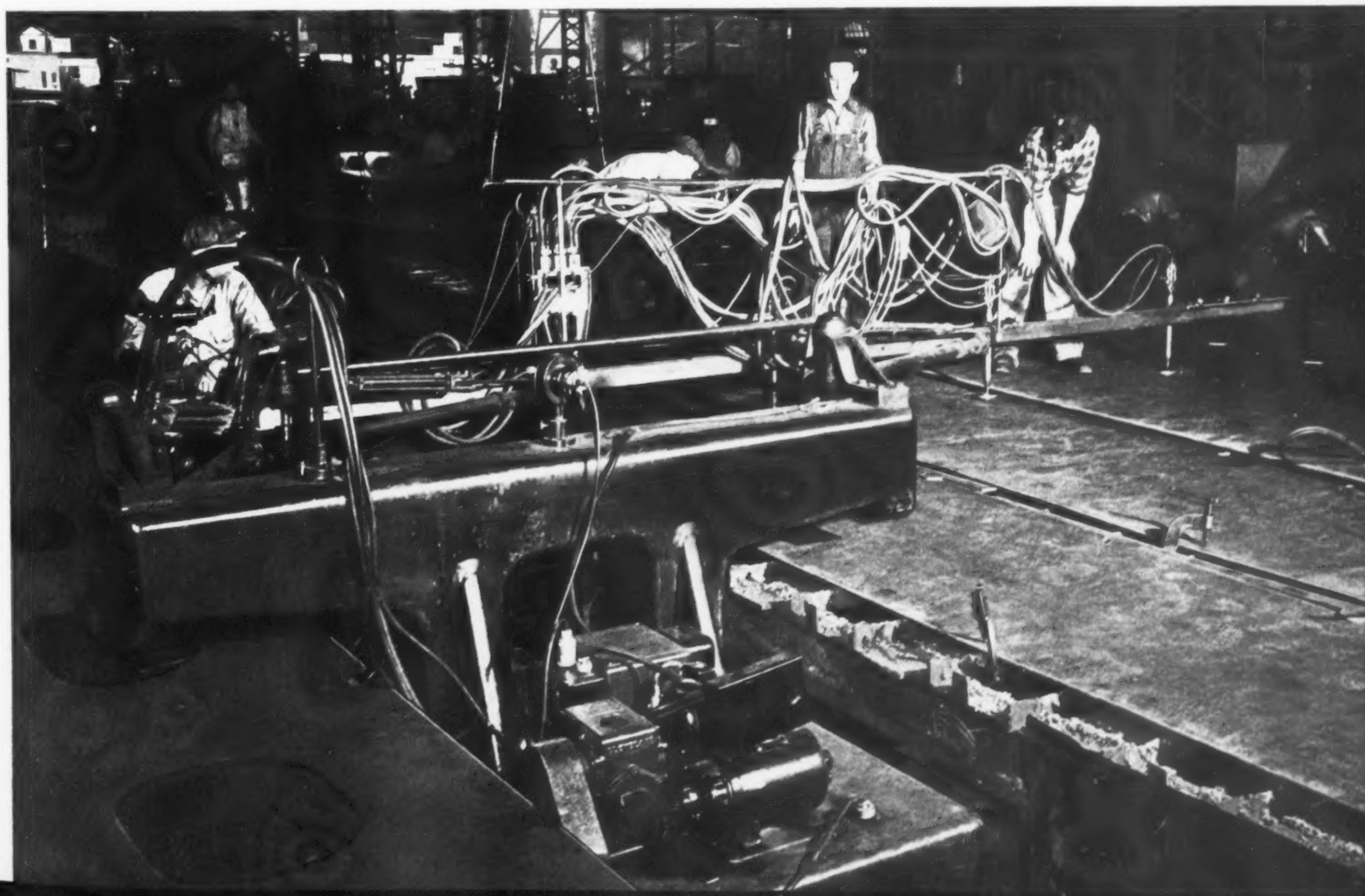
The Oregon shipyard is devoted entirely to the building of the EC2-S-C1 cargo vessels, or Liberty ships as they are popularly called, of which the Maritime Commission plans to build approximately sixteen hundred by the end of 1943. Liberty ships are of a basic English design which was modified to enable building them by mass production methods formulated in America. These vessels have an overall length of 441 feet 6 inches, a beam of 57 feet, a depth of 37 feet 4 inches, a total displacement of 14,100 tons, and a general cargo capacity of 9146 tons. They are of the single-screw, full-scantling type with a raked stem and cruiser stern. The hull is subdivided by seven main bulkheads, thus providing five cargo holds. The cost of each Liberty ship has been estimated to be about $1,800,000.

There are only 25,500 rivets in the entire hull of Liberty ships, whereas the famous Hog Island vessels of the last war required considerably over one million rivets on each ship. However, Liberty vessels require approximately 221,000 feet of welding, whereas there was little or no welding on the Hog Island ships. The fact that Liberty ships are welded rather than riveted is one reason why they can be built so rapidly.

When the Oregon shipyard was started in February, 1941, there was nothing on the site but empty fields and swamp land. Land had to be filled in and an outfitting basin dug that would be long enough to enable at least five vessels to be docked end for end at one time, and wide enough to permit at least three ships to be anchored side by side. Shops had to be built and shipways erected. Within seven months the first ship was launched.

About the only men of supervisory capacity in this shipyard who have had previous shipbuilding experience are the hull superintendent, marine superintendent, and erection superintendent. The general manager, chief engineer, general shop superintendent, plate shop superintendent and other key men in the organization

Fig. 2. Travograph Oxy-acetylene Equipment, which Automatically Cuts out Ship Plates, Three at a Time, from a Duplicate Metal Templet



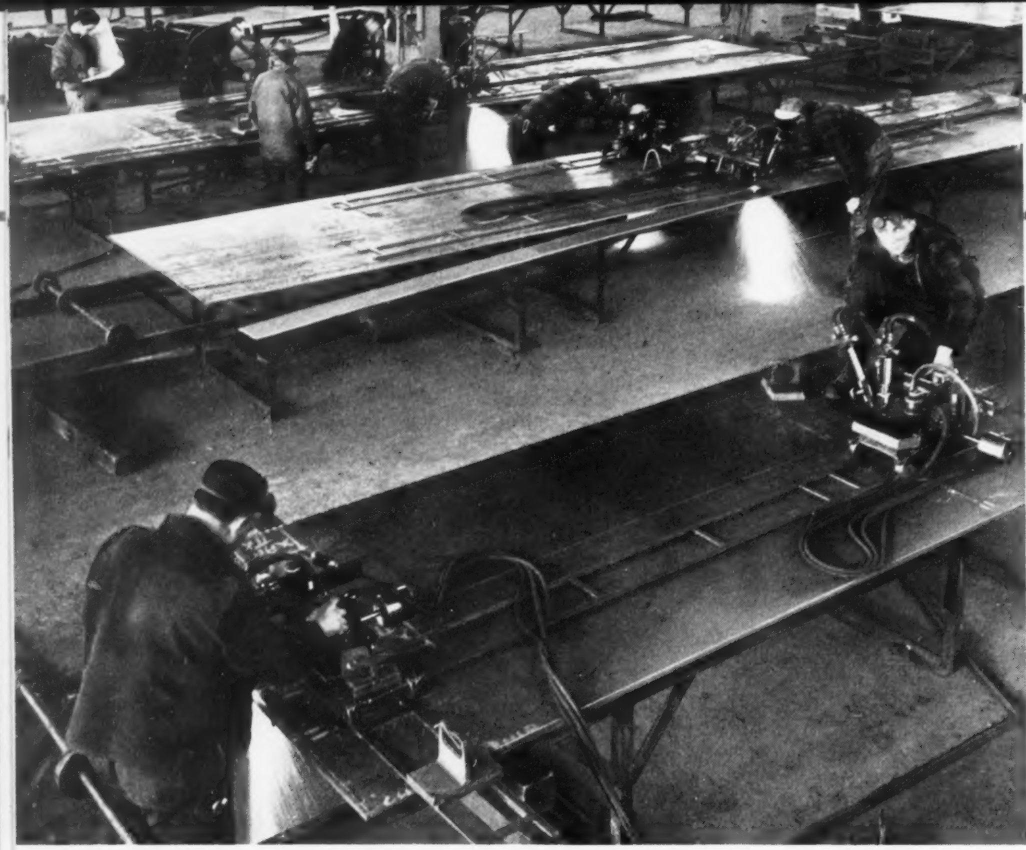


Fig. 3. Oxy-acetylene Machines, Arranged to Travel Automatically on Tracks, Cut out Plates in Straight Lines

are simply general construction men of proved ability in the successful undertaking of big jobs. There are approximately 35,000 employes in this shipyard, and it is operated seven days a week, twenty-four hours a day. There are about 2220 employes in the plate shop alone, where plates are cut out by oxy-acetylene machines and shears to required dimensions for fabrication into various units, shaped by hydraulic or mechanical presses to required contours, drilled for rivets, and so on. Over 1200 tons of plate goes through this shop every day—enough steel every two and a half days for a complete ship.

The plate shop operates as a well organized production line. Plates are chalk-marked or scribed from templets, cut to size, stamped or drilled, trimmed, and eventually sent from the shop ready to be fabricated in the assembly building. The material is carried into the plate shop from an outside storage area by large bridge cranes, which have a rated capacity of 40 tons. Inside the shop, the plates are transferred to smaller bridge cranes having lifting capacities of from 5 to 15 tons, and are placed by them on steel horses and platforms.

Wooden templets are then clamped to the steel plates. Ship fitters outline the shape of the required pieces by driving prick-punches through

Fig. 4. Cutting out Angle Clips and Other Small Pieces from Steel Plate Laid out with Chalk Lines in a Way that Practically Eliminates Scrap

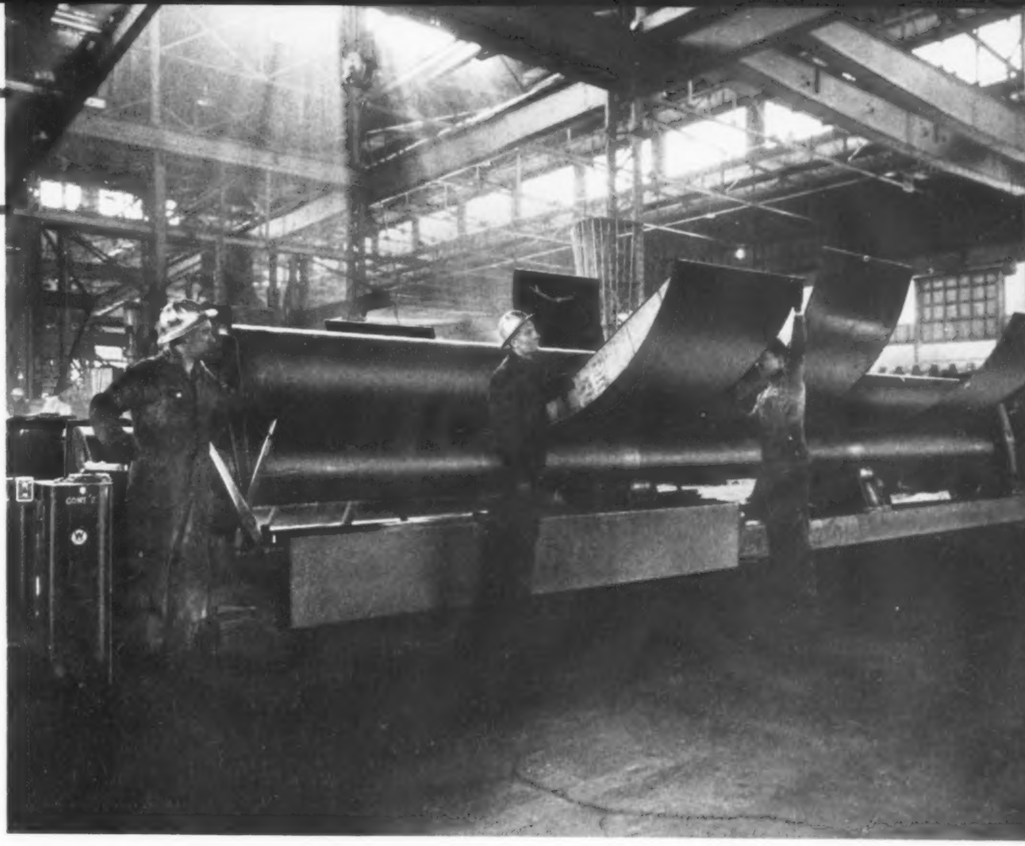


Fig. 5. Huge Horizontal Rolls—32 Feet Wide—which are Used for Bending Ship Plates to Large Radii

holes in the templets. Lines are then drawn with chalk from center-punch to center-punch or scratched with scribers. All code markings on the templets are painted on the steel plates to indicate the size and position of holes, to give necessary instructions to the operators of oxy-acetylene cutting equipment, and to provide other information.

Hand, semi-automatic, and automatic oxy-acetylene cutting machines are used, one of the most interesting being the Travograph, shown in Fig. 2, which is completely automatic. This machine, of which there are two in the shop, may be equipped with two to four Airco cutting heads, and can be used for cutting as many as three separate plates up to 45 inches wide at one time. The templets are generally of steel plate, and are the exact duplicates of the plates to be cut. An electromagnet automatically follows the edges of the steel templet and guides all the cutting torches in similar paths over the work. Sometimes paper templets are used, in which case the operator guides the tracer wheel over the templet lines to control the cutting torch movements. The Travograph tables are long enough to permit plates to be set up ahead of those being operated on, ready for cutting.

Planographs, which are somewhat smaller

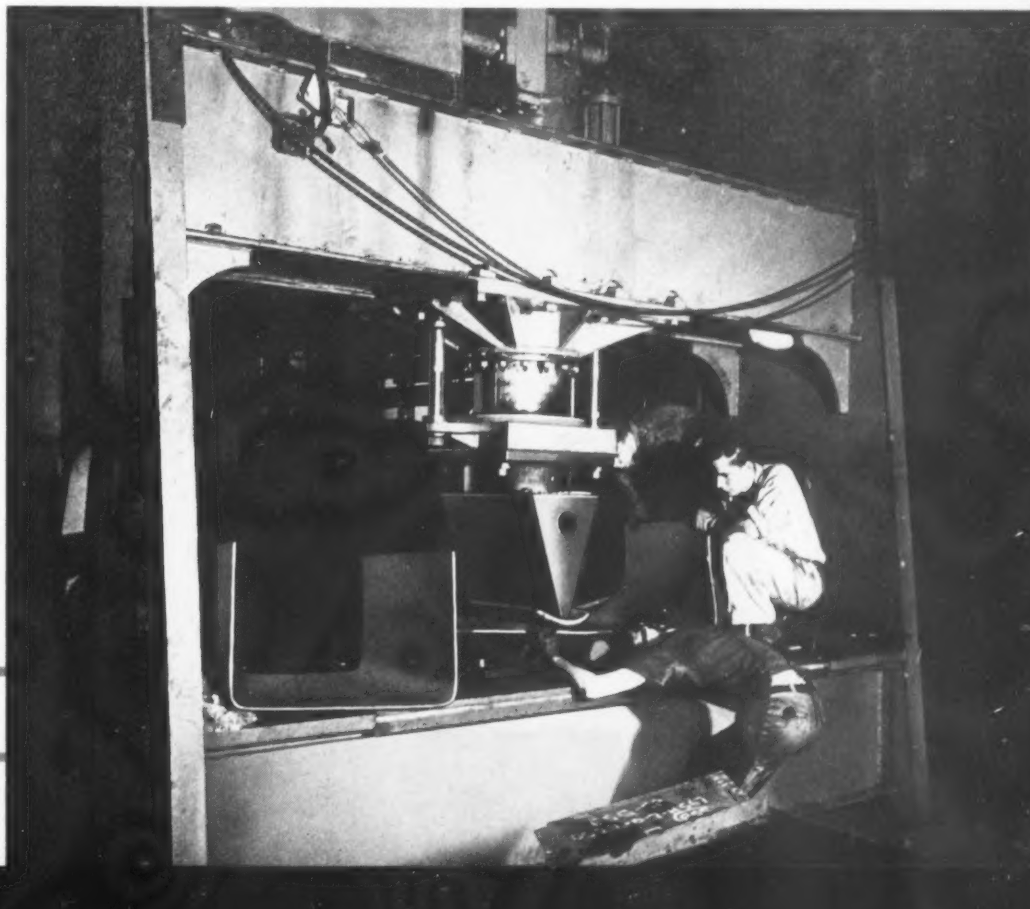
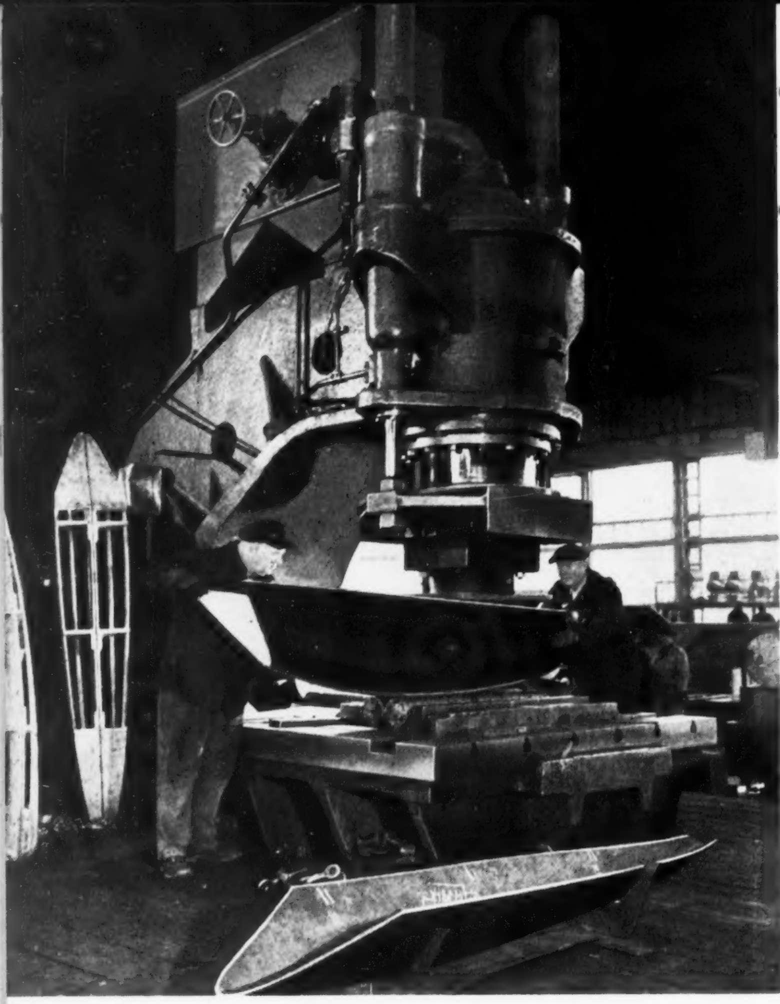


Fig. 6. Bending a Transition Plate to Acute Angle on a 200-ton Press which Performs Operations Similar to Those Done on the Machine in Fig. 7



prepare many plate edges for welding by beveling one or both sides. Beveling is accomplished by mounting the torches of the Travograph and Planograph machines at an angle. Thus, as the torches travel along the edge of a plate, a 45-degree bevel may be cut along the upper edge and a 30-degree bevel along the bottom edge in one operation. Both the Travograph and Planograph do beveling and angle cutting at the rate of 10 inches a minute on plate 1 1/4 inches thick and at a speed as high as 22 inches a minute on plates 1/4 inch thick.

As material is of more importance than ever before due to wartime demands, the effort is constantly being made at the Oregon shipyard to utilize raw materials to their utmost. Without close control of the plate-cutting operations a considerable amount of steel scrap would obviously be obtained, and this condition prevailed until several key men conceived an idea that has virtually eliminated scrap from the plate shop.

The first step in working out this idea was the construction of a large photographic tower having a room 35 feet square. The floor of this room was painted black with squares 1 foot wide, indicated by white lines. Templets made in the mold loft are laid out on this accurately marked floor and photographed by a Graflex camera, which is located 40 feet above the center of the room. Glass plate negatives are used to obtain maximum accuracy.

than the Travographs, are used for cutting manhole rings, small brackets, dies, etc., from steel. Straight lines are cut with automatic Airco Oxygraph machines, which travel on tracks carefully laid out on the steel plates in the manner illustrated in Fig. 3.

All plate edges must be cut smoothly, so that they will fit against other plates to which they are later to be welded. It is also necessary to

Fig. 7. (Above) Keel Plates, Fashion Plates, and Similar Work is Bent to Required Forms under a Hydraulically Actuated Joggling Press

Fig. 8. (Left) Horizontal Bending and Straightening Machine Employed on Structural Members that Must be Bent Slightly or Merely Straightened

Builds Ships

Enlargements are made from the glass plate negatives to bring the 1-foot squares of the floor to a width of 1/2 inch on the photographic prints. The finished prints are made on aerial mapping print paper to insure the highest possible accuracy. These photographs present an exact picture of the templets, with all shapes and markings accurately produced to a scale of 1/2 inch to the foot. These pictures of the templets are then cut apart and filed according to the templet numbers.

Draftsmen fit these pictures together on a predetermined outline that corresponds in scale to a piece of steel plate, and rearrange the pictures until the area of the plate is filled as nearly as possible. Lay-out diagrams are then made and sent to the plate shop, where they are filed by code number.

Whenever the hull control department issues an order for steel, the order carries the file code number of the lay-out diagram to be used. A similar order goes to the mold loft for supplying to the plate shop all the templets called for by any particular lay-out.

Besides saving a great amount of steel, this practice has cut down the lay-out time of the plate shop tremendously; it is estimated that the method saves lay-out men and duplicators in each bay of the plate shop at least two hours a day, and the system is so economical that it is paid for by the saving of one piece of steel measuring 4 by 6 feet from each ship.

In Fig. 4 are seen several operators engaged in cutting out comparatively small flat and bent steel plates on which parts have been laid out with chalk in such a way as to use up practically all of the material. Such parts as angle clips, strongbacks, saddles, lifting eyes, dogs, and butterflies are cut out in this department, which employs about thirty oxy-acetylene torch operators in each shift.

Fig. 9. (Above) Punching Machine Used for Producing the Holes Required for Attaching Structural Members to Vessels by Means of Rivets

Fig. 10. (Right) Small and Medium-sized Sub-assemblies are Welded on Positioners which Enable the Joints to be Placed Horizontally

The steel plates are rolled to large radii on huge horizontal rolls, such as seen in Fig. 5. This machine is driven by a 60-H.P. motor, and is equipped with another motor of 40 H.P. for adjusting the vertical position of the upper roll in order to control the radius to which the plate is to be formed. Plates 1/8 to 15/16 inch thick, 12 to 30 feet long, and 42 to 85 inches wide can be handled by these rolls. The upper roll weighs 30 tons, and the two lower rolls 15 tons each.

Another important machine in the plate shop is the Baldwin Southwark 400-ton joggling press shown in Fig. 7, which is provided with a hydraulically operated ram. Various types of dies are used on this machine to shape plates to more acute angles than can be obtained on the horizontal rolls, and also to bend the plate in different planes. Such ship members as the keel, fashion, diaper, boss, and transition plates are formed in this machine to set-molds or templets built up of wood.

In Fig. 6 is shown a McCulloch 200-ton press used for doing the same class of work. At the time that this photograph was taken, the operation consisted of bending a transition plate to an acute angle by the use of an angle-iron that was temporarily welded to the punch. After the performance of the operation the angle-iron was burnt off.

The many structural members that make up the backbone and ribs of ships are also bent in this shop on conventional bending slabs after they have been heated to about 2200 degrees F. in oil-fired furnaces. The heated steel is formed to steel templets by workmen using 20-pound sledge hammers.

Some structural members are bent to templets by means of the Buffalo horizontal bending and straightening machine shown in Fig. 8, and this equipment is also used for straightening structural members. This machine is installed adjacent to the Cleveland punching machine shown

Fig. 11. Storage Space at the Head of One Bay of the Plate Shop. A "Hyster" Truck can be Seen Bringing in a Skid Loaded with Steel Plate

in Fig. 9, where structural members are punched to receive rivets.

Some welding of smaller sub-assemblies is performed at one end of the plate shop, particularly members that must be welded in several different planes and that can best be handled on welding positioners. In this way, all joints to be welded can be placed in a horizontal position for maximum welding convenience. In Fig. 10, a typical operation of this kind is shown being performed on a Cullen-Friestedt positioner.

The work produced by the plate shop is carried by the overhead bridge cranes to a storage space at one end of the building, one of the bays of this storage space being seen in Fig. 11. Here the plates are deposited on steel skids constructed with vertical arms that hold the plates approximately vertical. These loaded skids can be readily lifted by "Hyster" trucks, such as seen in the center of the illustration, to be conveyed to the assembly shop. "Hysters" can carry loads up to about 10 feet in height and have a capacity of 14 tons. The operator sits on a buggy seat on top of the truck, where he has a practically unobstructed view. When one of these trucks is in motion, a horn sounds constantly to warn pedestrians and other truck-drivers. These work-handling units are also used to carry steel plates to the plate shop.

Up till midsummer of this year, the fabrication of the various assemblies for the ships was performed on platforms located between the plate shop and the eleven shipways. At that time, all the welded units for any one ship were fabricated on one platform by a single group of men, and carried by gantry cranes directly to the ships. There were several difficulties with this arrangement, a principal one being that so much space was often occupied in fabricating large units, such as bulkheads, that it was impossible to start the fabrication of other units

Fig. 12. One of the Eleven Bays in the Assembly Building, This Bay being Devoted Entirely to the Prefabrication of Inner Ship Bottoms

until the platforms were cleared off. Thus production delays were inevitable. Another fault with the system was that the welders could not be as proficient as if their work was confined to one or two units.

To enable truly interchangeable and uninterrupted production of the fabricated units, it was decided to construct an assembly building, 855 feet long by 240 feet deep. In typical Kaiser fashion, this huge building was put up complete within seven weeks. It is constructed with eleven bays, each 75 feet in width. Bays 1 and 2 are devoted entirely to the prefabrication of inner bottom sections. Deep tanks are built in Bay 3, main bulkheads in Bay 4, second deck units in Bay 5, second deck units and between-deck bulkheads in Bay 6, upper deck sections in Bay 7, deckhouses and bulkhead assemblies in Bays 8, 9, and 10, and upper decks and gun platforms in Bay 11. One of the bays devoted to the fabrication of inner bottoms is shown in Fig. 12.

Storage areas are laid out at the head of each bay, as shown in Fig. 11, to accommodate plates and structural members for six to eight duplicate sections. The method of storage is such that relatively inexperienced workmen can make a complete inventory in a few minutes, a job that requires hours of a foreman's time in some shipyards. From the storage or receiving area, overhead cranes move the materials into the assembly bays, each bay being provided with two bridge cranes having rated capacities of from 10 to 25 tons.

The fabricated sections are moved ahead as work progresses, and finally emerge at the opposite end of the assembly building, from which point they are transferred by large Whirley cranes of the type seen in the heading illustration, which run on tracks along the entire length of the assembly building. These cranes place the fabricated sections on sixteen-wheel trailers. Inner bottoms and deep tanks emerge from the first three bays upside down, because it is necessary to construct them in an inverted position. They are turned over by the Whirley crane and placed right side up on the trailers.

Welding of all vertical joints and joints that connect vertical plates with horizontal plates is done by electric arc welding in this assembly building. However, flat deck plates, the tops of inner bottoms, and similar plates are joined by Unionmelt welding, a typical operation of this kind being shown in Fig. 13. Generators for the Unionmelt welders are mounted in self-contained housings which can readily be transported by means of the overhead cranes to any point in a bay. The generators for the electric arc welding sets are installed on platforms between the bays. Twenty-five hundred workers are employed in the assembly building.

The trailers used to carry the huge inner bot-

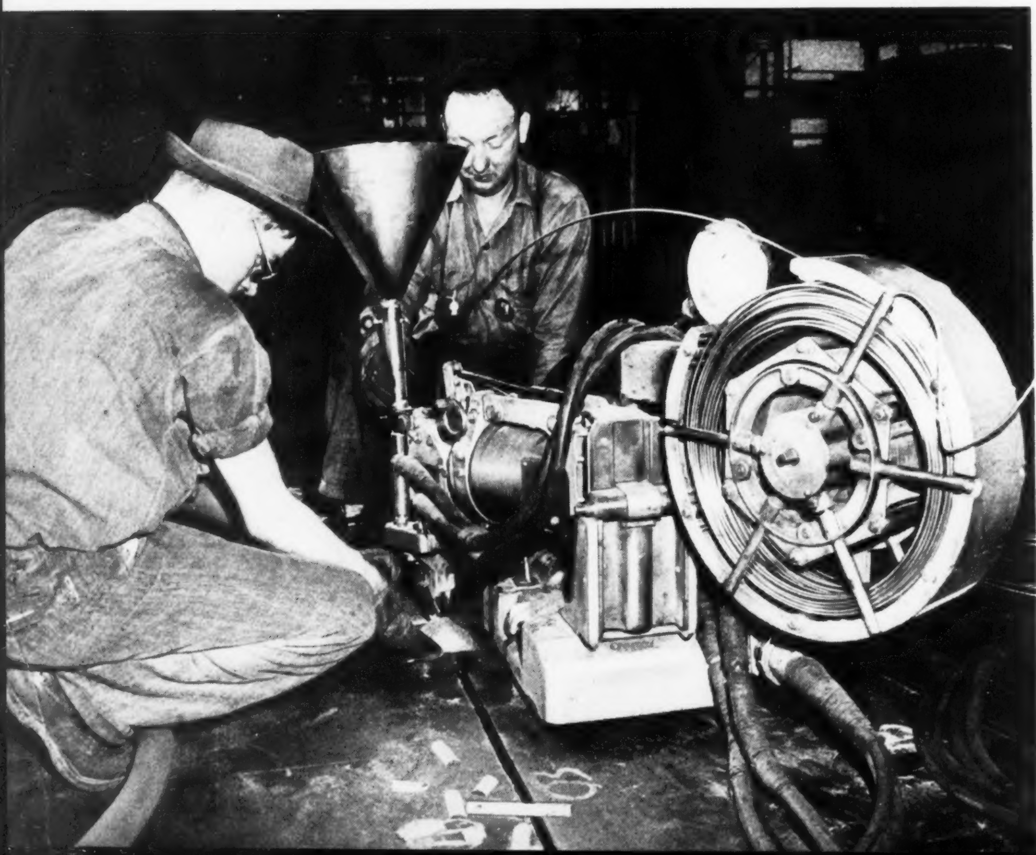


Fig. 13. Joining the Top Plate of Inner Bottoms by Means of the Unionmelt Welding Process

toms, bulkheads, etc., from the assembly shop to storage and to the shipways are constructed with 16 wheels equipped with 13- by 24-inch rubber tires. The truck platforms measure 30 feet long by 16 feet wide, and carry loads weighing up to 85 tons. These trailers are pulled from the assembly building to the shipways by Caterpillar power units.

Hatches are fabricated into one piece on yard platforms, as are also the afterdeck houses. The boat deck and bridge are fabricated in four sections which are assembled aboard ship. Even the bull rings are prefabricated.

Shipway operations are facilitated by twelve Whirley cranes which run on tracks of 28 1/2-foot span between the ways. They have booms 95 feet long, with a 10-foot jib at the outer end of the boom, giving them sufficient length to reach any point across the ways. Besides these cranes there are eleven others of the same type which serve the assembly shop and the outfitting dock. They range in capacity from 40 to 60 tons. Four of the Whirley cranes on the outfitting dock can be seen in the heading illustration, while others can be seen between the shipways in Fig. 1.

In starting the construction of a new ship, the keel is laid first. The keel is made up of plates that extend the full length of the vessel in the middle. Additional shell plates are then assembled by Unionmelt welding until the entire bottom of the ship has been constructed, after which the prefabricated inner bottoms are attached. Large concrete blocks, weighing 20 tons apiece, are placed on top of the inner bottom sections to press them down tight on the bottom shell and thus facilitate welding them in place. From four to six of these weights are customarily placed on one inner bottom section.

After these sections have been welded to the bottom shell, the bulkheads are put in place, and the sides of the hull are gradually constructed. Then the decks and the remainder of the vessel are fabricated in rapid sequence, even the boilers, engines, masts, etc., being installed before launching. The scaffolding around the ways is constructed of wood and remains permanently in place, except for a small section at the bow end of the vessel, which is withdrawn in one unit for the launching ceremonies.

There are, of course, other shops in this shipyard, besides those already described, in which there are many operations that have resulted in short-cuts in production. Studs and bolts from 1 1/8 to 1 7/8 inches in diameter required for a large variety of purposes aboard ship, are produced two at a time on the Landmaco double-head threading machine in Fig. 14.

Operations in the machine shop and pipe shop of this shipyard will be described in a second installment of this article, to be published in a coming number of MACHINERY.

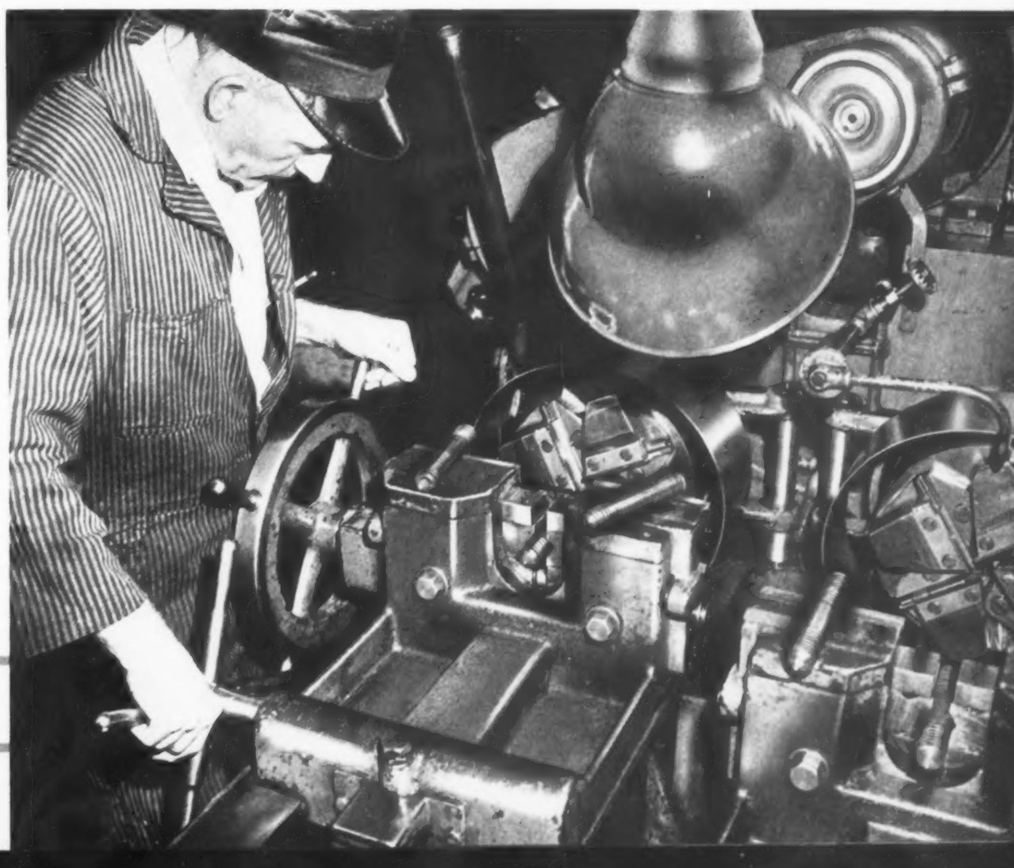


Fig. 14. Double-head Threading Machine Employed for Making a Variety of Studs and Bolts

Liberty Ships are Driven by

Fourteen Manufacturing Concerns, Spread Across the Continent, are Engaged in Producing Marine Steam Engines for Propelling Liberty Ships—This Article Describes Mass Production Methods Employed by the Hooven, Owens, Rentschler Division of the General Machinery Corporation in Building Twenty of These Engines per Month

By THOMAS GILMORE, Works Manager and
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The Hooven, Owens, Rentschler Division of
the General Machinery Corporation

Approved for Publication by the U. S. Maritime Commission

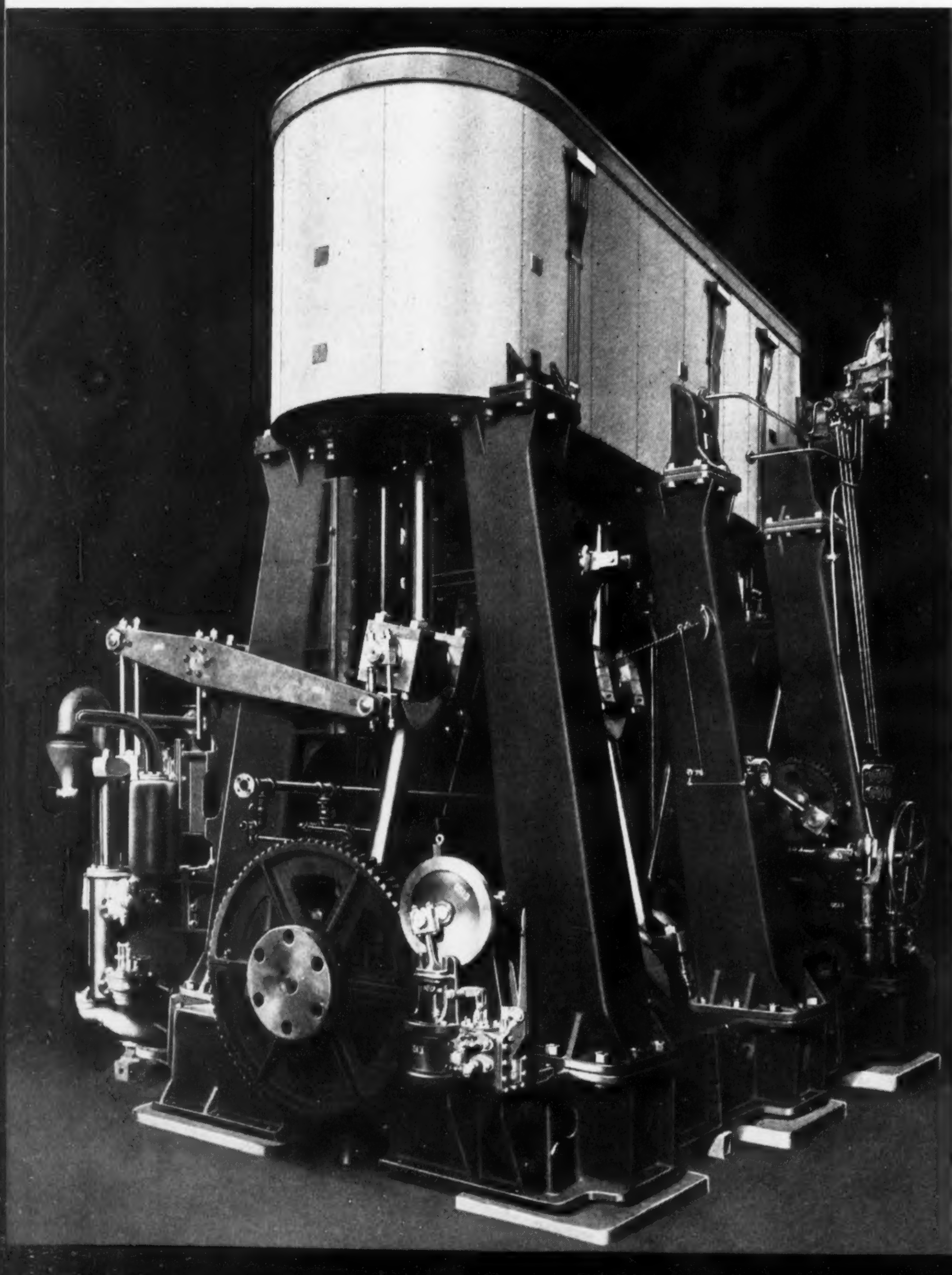


Fig. 1. Operating Side of the Triple-expansion Marine Steam Engine that Propels the Liberty Ships

Triple-Expansion Steam Engines

MARINE steam engines of vertical triple-expansion type are used for driving the EC2-S-C1 cargo vessels, or Liberty ships, being built for the United States Maritime Commission. The three cylinders of these engines are 24 1/2, 37, and 70 inches in diameter, which, with the piston stroke of 48 inches, develop 2500 indicated horsepower at 76 R.P.M. of the crankshaft. The operating side of one of these engines is illustrated in Fig. 1, and the exhaust side in Fig. 2. Each complete engine has a weight of approximately 271,000 pounds, or 135 1/2 tons.

Back in the days of the first World War, the Hooven, Owens, Rentschler Co., Hamilton, Ohio, established a noteworthy record in building marine engines. High production was attained through the introduction of revolutionary foundry practices and the use of jigs and fixtures that permitted interchangeable manufacture of the engine parts. Based on this experience and also on practices developed in the building of Corliss engines, the Hooven, Owens, Rentschler Division of the General Machinery Corporation promised the United States Maritime Commission a year ago that it would build steam engines for driving the Liberty ships at the rate of eight engines a month. At the time, this was

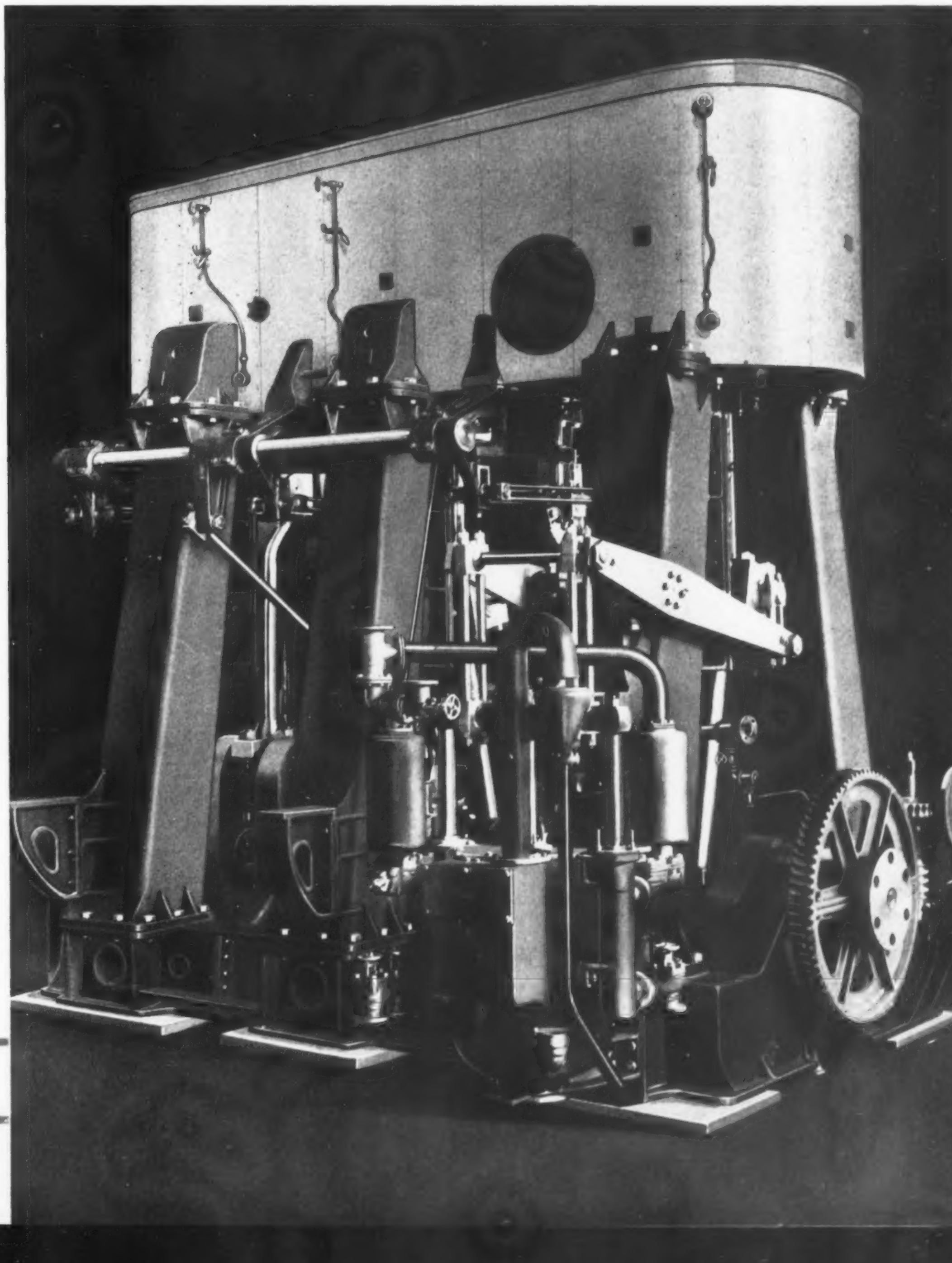


Fig. 2. Exhaust Side of the Marine Engine Shown in Fig. 1, which Develops 2500 Indicated Horsepower

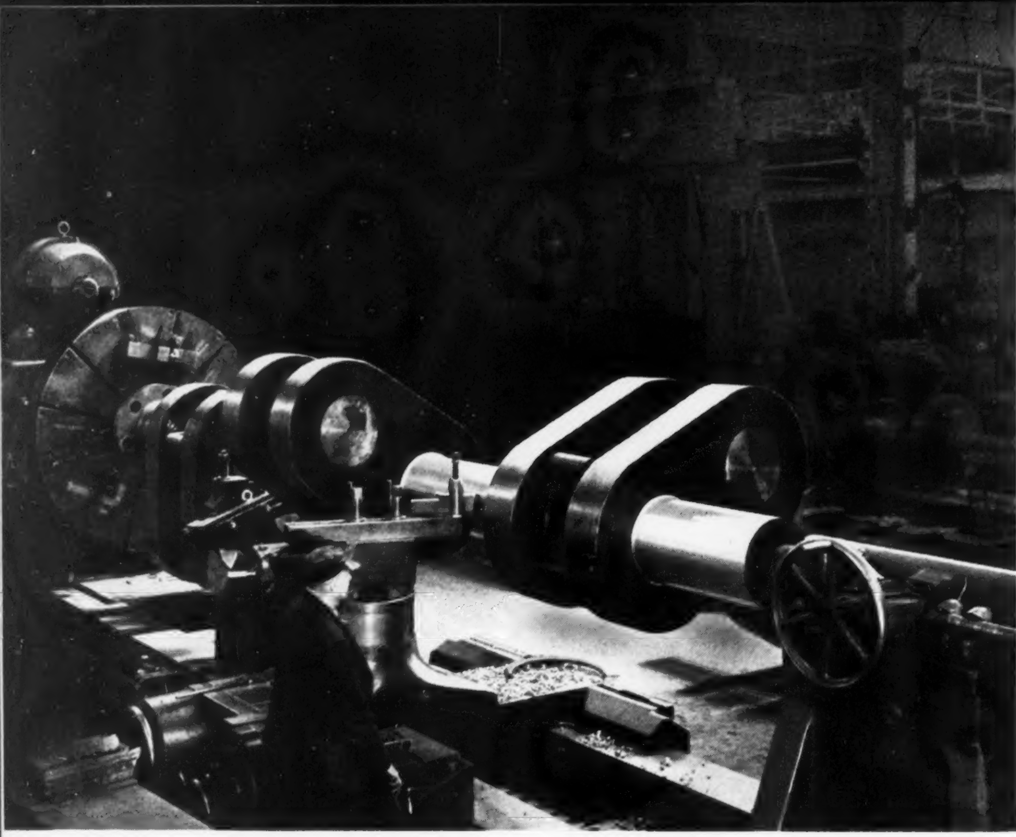


Fig. 3. Finish-turning Six Main Bearing Journals on a Built-up Crankshaft

considered an objective almost impossible of attainment. Today, the concern is turning out an average of twenty of these engines per month, and it is anticipated that the production rate will soon be one engine every day. Small wonder, then, that this concern was the first in the machinery group to win the Maritime Commission's Award of Merit.

English drawings for these engines were received at the Hooven, Owens, Rentschler plant on the last day of December, 1940. It was necessary to develop a complete new set of drawings covering every detail part, based on American ideas of manufacture and tolerances. In spite of the vast amount of work entailed in preparing the drawings and in the development of jigs and fixtures for advanced manufacturing methods, the concern was able to complete its first engine by July 1, 1941—only six months after the drawings were received. There are approximately nine hundred employes in the engine plant.

Today's production records are based on a wider use of jigs and fixtures than has been the practice previously in building marine engines. The more than one hundred thousand dollars expended for this tooling insures such a high degree of accuracy in engine parts when

Fig. 4. Turning an Intermediate Section for a Crankshaft, Ready for Shrinking into Crank Webs. Journal is Rough-turned in Same Set-up

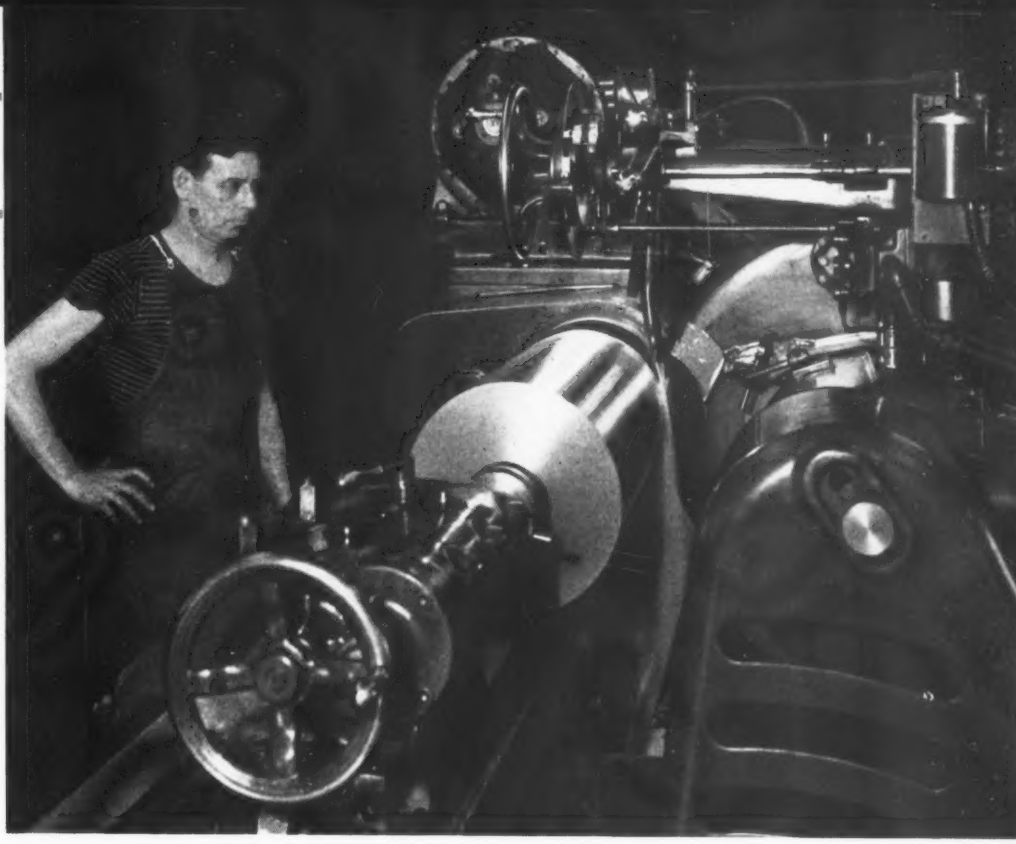


Fig. 5. Finish-grinding a Crankpin to Size prior to Shrinking into the Crank Webs

they leave the machine tools on which they are finished that assembly problems on the erection floor have been practically eliminated. Whereas original estimates had indicated an erection time of two and one-half weeks per engine, the time from the setting up of the bedplate to the shipping of an engine has been cut to as little as five days.

Typical machining operations on a variety of parts for these engines will be described in this article. The designs for much of the special tooling, as well as the detailed engine drawings, were made available to the thirteen other concerns in this country and to the four Canadian companies that are engaged in building the same engines. This procedure obviated much duplication of effort and materially speeded up engine delivery.

The built-up crankshafts are made up of crankpins and shafts that are shrunk into forged or cast-steel arms or crank webs. Each crankshaft is made up of two sections, the forward section being connected to the high- and medium-pressure cylinders, and the aft section to the low-pressure cylinder. Together with the eccentrics and straps, the complete crankshaft has a weight of 40,000 pounds. Finish-turning operations are performed after the crankshaft

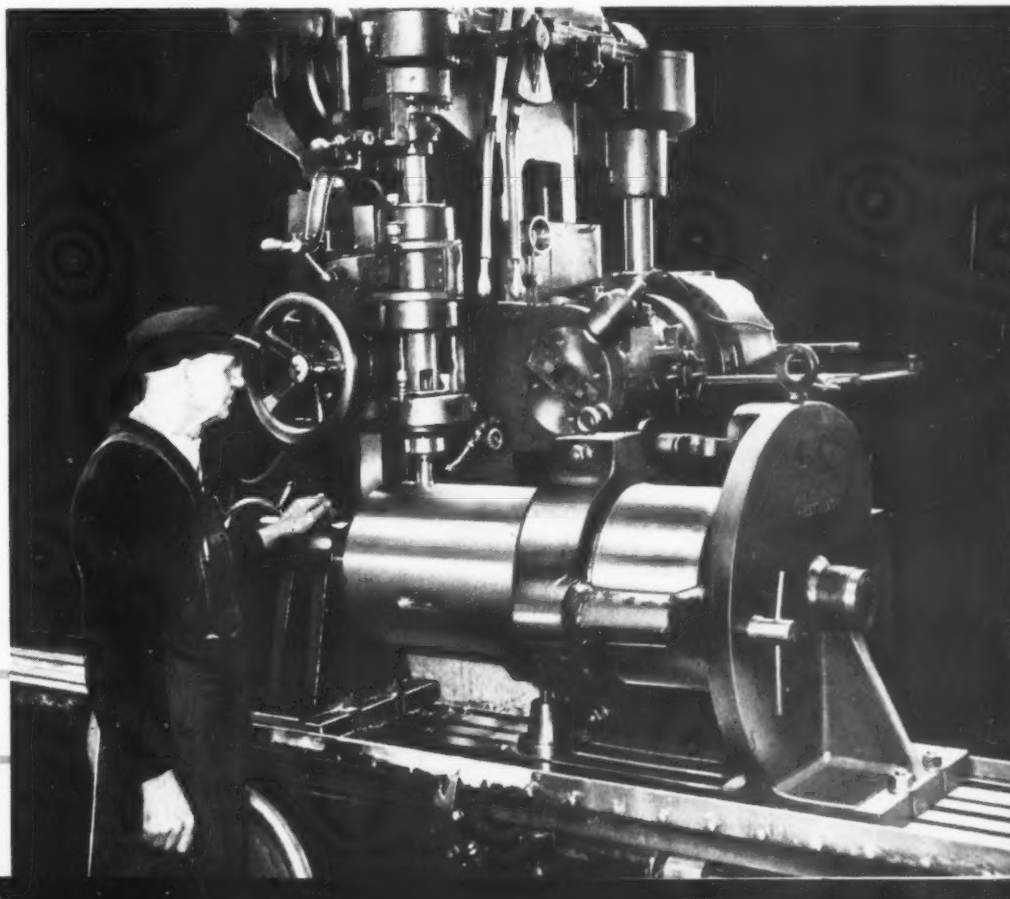


Fig. 6. Keyways are Milled in Crankshaft Sections in Close Angular Relation to Each Other by the Use of a Special Jig

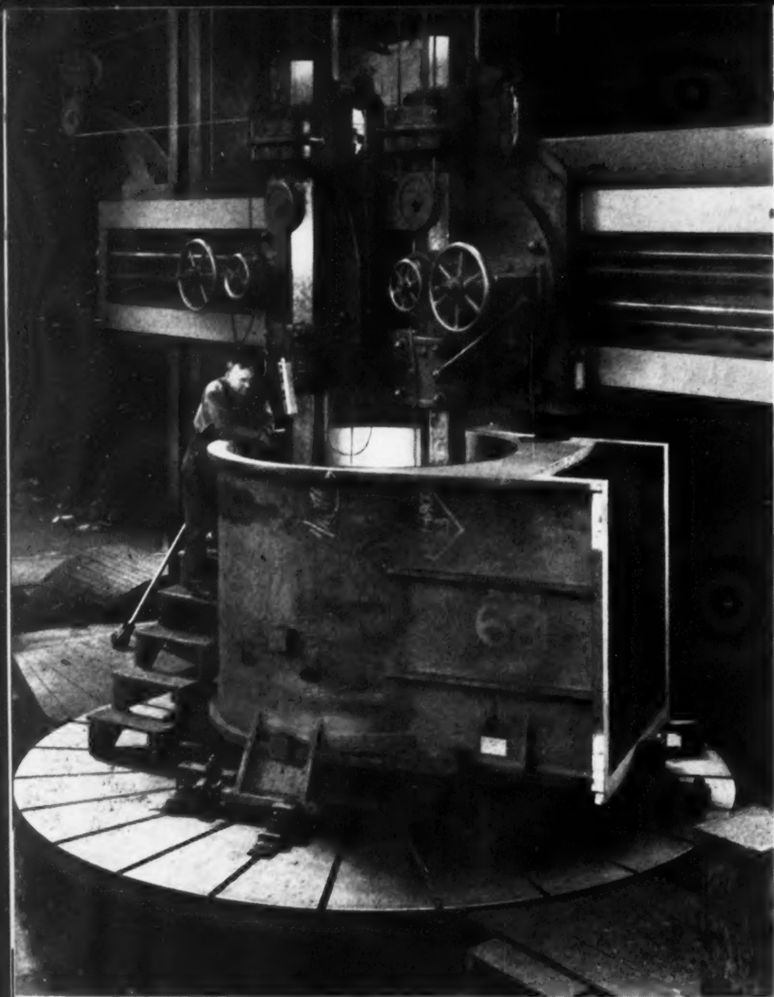


Fig. 7. Boring a Low-pressure Cylinder to a Diameter of 70 Inches within Plus or Minus 0.002 Inch on a 20-foot Vertical Boring Mill

has been assembled, as will be seen in Fig. 3, where six journals are being turned to a diameter of 14.250 inches within plus 0.000, minus 0.002 inch. Two of the journals are 16 inches long, and the others 15 inches long.

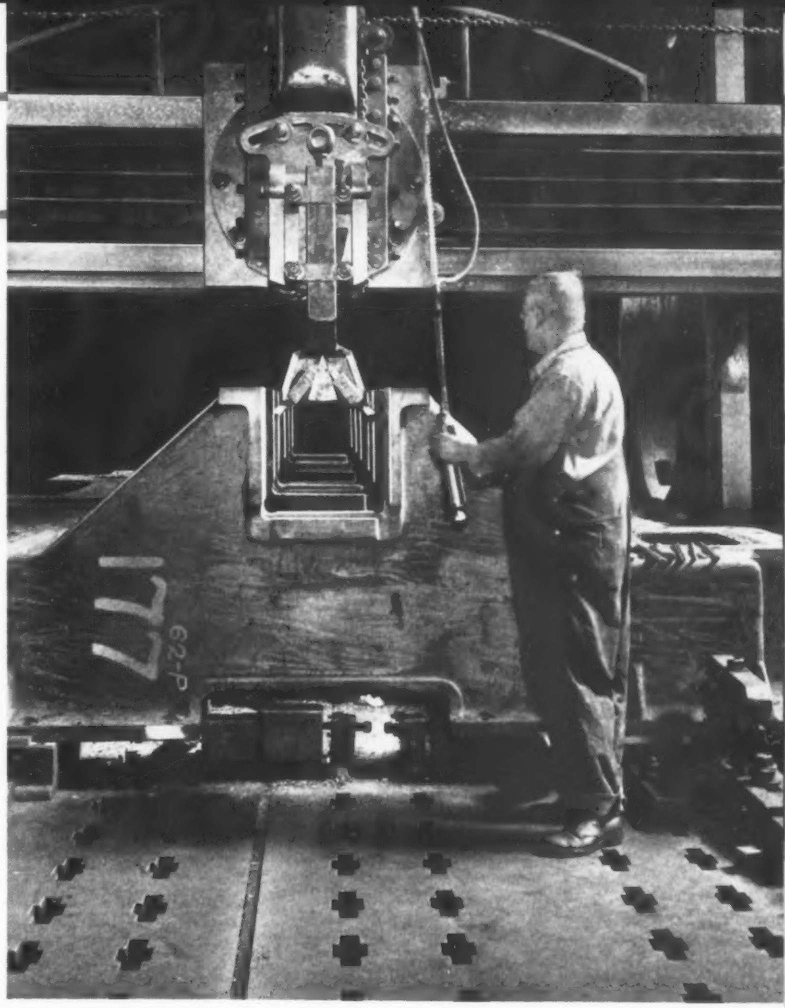
To prevent sagging or weaving of the crankshaft during turning operations, spider-like castings are located between each pair of crankshaft webs. These spiders are provided on each end with a centering pin that is positioned in the center holes of the two shafts on which the webs are mounted. Then three screws on the spider arms are tightened against the crank webs to hold them apart. A steadyrest is also used near the middle of the 21-foot 3-inch long crankshaft to further support it. When the crankshaft leaves this machine, the journals must all be in dead alignment with each other. At the most, they cannot be more than 0.004 inch out of alignment from one end of the crankshaft to the other.

Carbide-tipped tools are used in taking roughing and finishing cuts on the crankshaft journals, the cuts being taken with the tools turned downward and the crankshaft revolving opposite to the normal direction. It takes from fifty to fifty-two hours to complete turning the journals. The machine shown in Fig. 3 is a Niles lathe of 85 inches swing.

In Fig. 4, a crankshaft intermediate section is being turned in a Niles lathe, ready for shrinking into the crank webs. The journal sur-

Fig. 8. Face-milling the Exhaust Flange of a Low-pressure Cylinder on a Post Type Milling Machine

for Liberty Ships



face is also rough-turned in this operation. The tailstock end of the shaft is supported by a Nielsen ball-bearing center. In operations like this, the tolerance is customarily plus or minus 0.001 inch.

Fig. 5 shows a crankpin being finished on a Landis cylindrical grinding machine, also prior to shrinking into the crank webs. Crankpins are ground to a diameter of 14.250 inches within plus 0.000, minus 0.002 inch. They are 33 3/8 inches long over all. From 0.003 to 0.004 inch of stock is removed in grinding. A vacuum cup is applied on the headstock end for driving purposes, the crankpin being held on the regular center at the headstock end and on a ball-bearing center at the tailstock end.

Keyways are milled in the crankshaft sections by employing an Ingersoll milling machine of vertical design, as illustrated in Fig. 6. Two keyways are milled in each crankshaft section, and the radial distance between the keyways must be closely controlled. The operation is performed to the required accuracy by the use of an indexing jig.

Before the operation is started, a large split collar is bolted around the crankshaft section as shown. This collar has an arm or extension that is provided with a bored hole at the outer end. A large dowel-pin is slipped through one of four holes in the fixture plate and into the bore of this arm for locating the crankpin in milling one of the keyways. When this keyway

Fig. 9. The Beds for These Marine Engines are Made up of Three Sections which are Bolted together into One Unit prior to Planing

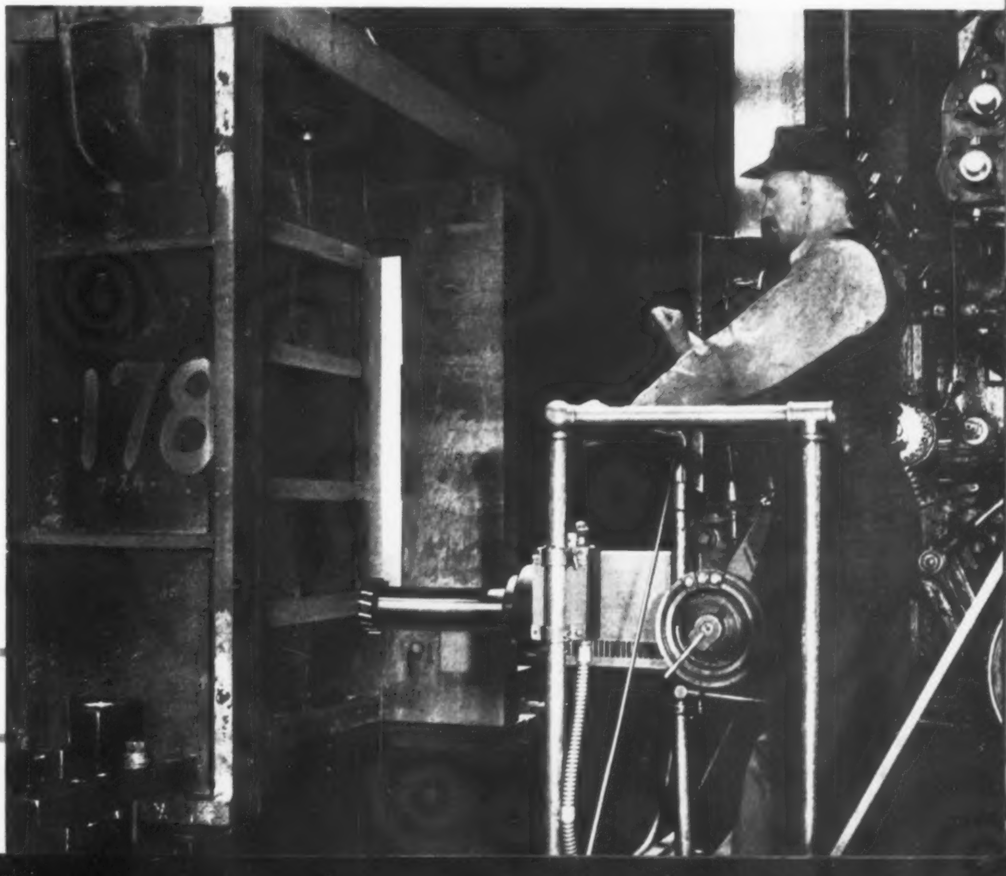


Fig. 10. Employing a Draw-cut Shaper for Milling the Valve Face of a Low-pressure Cylinder Casting

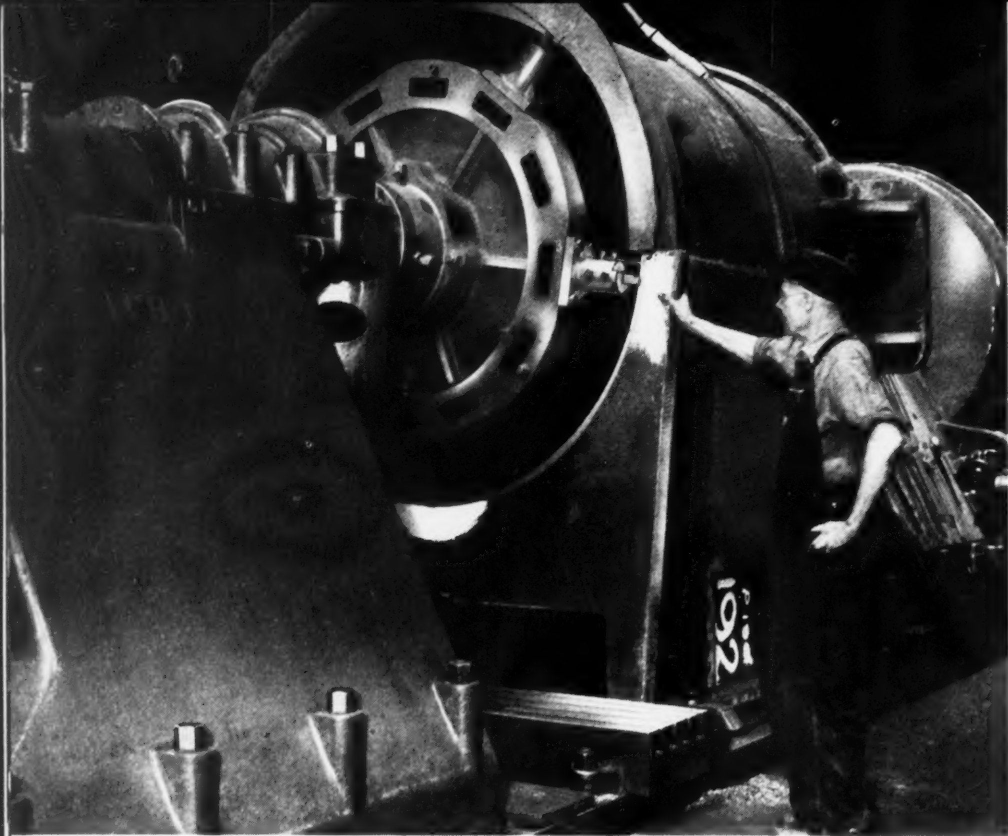


Fig. 11. Horizontal Boring Mill Set up for Cutting the Shrink-head from a Cylinder Casting and for Rough-machining the Cylinder Bore

has been finished, the dowel-pin is withdrawn and the work revolved on the fixture until the locating arm is brought into line with the second locating hole in the fixture plate. The dowel-pin is then inserted through this hole to locate the crankshaft correctly for milling the second keyway.

One fixture is designed for handling all three crankshaft sections. It insures the milling of keyways within an error of 1/64 inch around the arc between their planes of location. The keyways are cut by a 1 3/4-inch wide cutter of two-lip design to a depth of 1/2 inch and a length of 4 13/16 inches.

The three cylinders for each engine are individual iron castings which are bolted together on the erection floor by means of fitted bolts. In Fig. 7 the 18,500-pound low-pressure cylinder is seen on a Niles 20-foot vertical boring mill. The operation shown consists of finish-boring the cylinder to a diameter of 70 inches within plus or minus 0.002 inch for a bore length of 65 inches.

An Ingersoll post type milling machine is shown in Fig. 8 being employed for face-milling the exhaust flange on a low-pressure cylinder. The same machine is also used for milling the top face, valve face, cylinder connecting joint

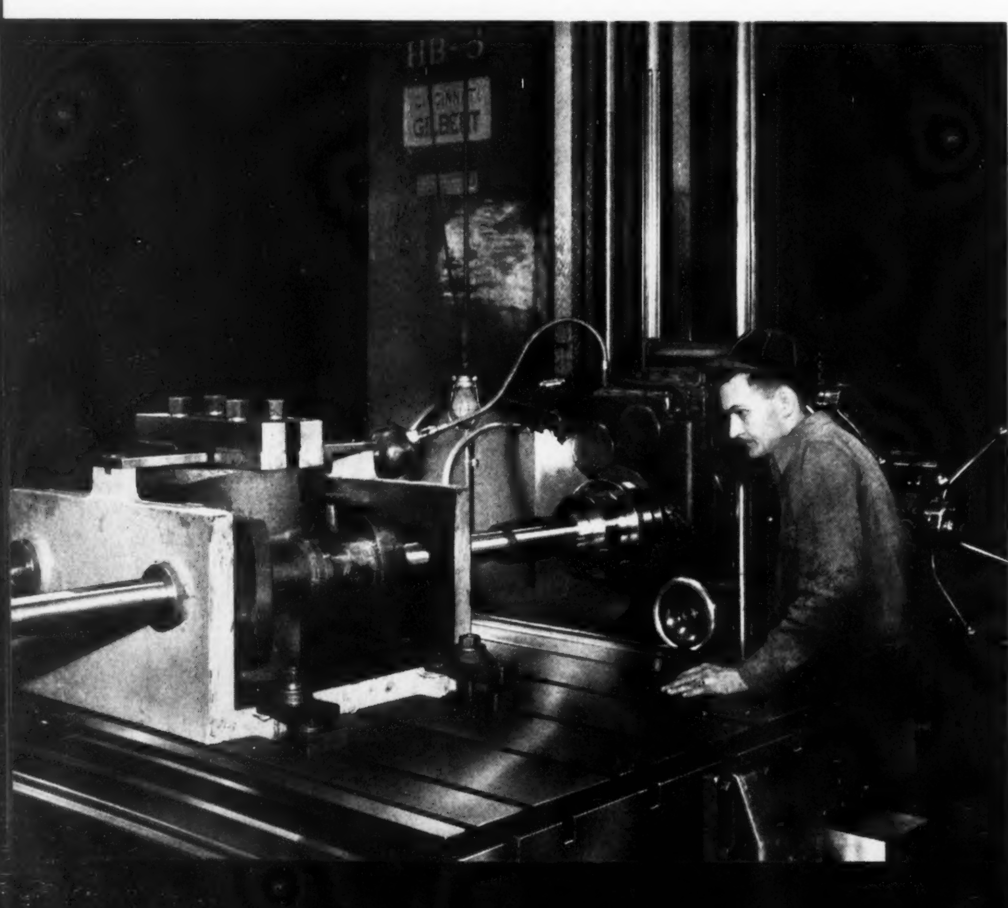


Fig. 12. Boring Bolt-holes of Crankpin Bearings in a Jig that Insures Accurate Center Distance and Close Parallelism of Bolt-holes

Fig. 13. A Hydrotel Milling Machine is Used for Face-milling Joint Faces of Crankpin Bearings prior to the Bolt-hole Boring Operation

and cylinder feet, as well as a number of small pads. Several different set-ups of the work are required on this machine. Fig. 10 shows an instance where the valve face on a low-pressure cylinder is being face-milled on a large Morton draw-cut shaper.

In Fig. 11 a low-pressure cylinder is seen set up on a Niles horizontal boring mill equipped with a 14-inch bar. This operation consists of cutting off the shrink-head around the upper half of the casting and of rough-machining the cylinder bore. Two cutters on a spider type tool-head are used in removing the shrink-head, while six cutters are mounted on the spider for boring. Stock to a depth of 1/8 inch is left around the cylinder bore to be removed in finishing.

The bedplate for these engines is made up of three cast-iron sections having a total weight of 36,500 pounds, which are also assembled together by means of fitted bolts. The bedplate comes as one unit to Niles 13- and 15-foot planers for finishing the column pads, main bearing pads, and other surfaces, as seen in Fig. 9. The illustration shows the simultaneous use of two cutters for machining opposite sides of the main bearing pads at one time. Each of the six bearings is planed with every forward

Fig. 14. Cross-head Blocks are Straight and Taper Bored on the Vertical Boring Mill Here Shown to Suit the Gage Seen on the Table

stroke of the table. The width between the vertical bearing pads must be held to 17 inches as closely as possible. A single cutter is used in planing across the bottom pads of these bearings, and also across the top bearing cap seats.

The bolt-holes in the crankpin bearings are bored accurately as to center-to-center distance and also in close parallelism by means of the jig shown in Fig. 12, on a Cincinnati Gilbert horizontal boring, drilling, and milling machine. The two half bearings go into the jig together. The finished bottom of one half is seated against vertical hardened and ground bars on the left-hand end of the jig. With the bearing halves in the jig, a locating bar is placed across the top of the jig, holes in this bar being seated on dowel-pins that are fastened to the jig.

Then the bearing halves are centralized in the jig by measuring the distances from the sides of the locating bar to the walls of the bearing bore with inside calipers. When the casting has been centralized, clamping screws on the right-hand end of the jig are tightened against the corresponding bearing half. The pilot of the boring-bar is next fed through one set of the jig bushings, after which clamps placed on top of the casting are attached to the jig by means of long bolts that are screwed into tapped holes in the bottom of the jig.

With the set-up as described, the bolt-holes are bored to 3.500 inches in diameter within plus or minus 0.0005 inch for a length of 15 3/4 inches. The center-to-center distance of 18.250 inches between the bolt-holes must be maintained within plus or minus 0.001 inch. Close accuracy in the boring is essential, because the bolts that are used to assemble the bearing halves are ground to fit the bore. Roughing, semi-finishing, and finishing cuts are taken with Rex AAA cutters on the steel castings.

The crankpin bearings are milled in pairs on their joint faces, prior to the boring of the bolt-holes, on the Cincinnati Hydrotel milling machine shown in Fig. 13. A helical inserted-blade face milling cutter, about 8 inches in diameter, is used for this operation.

Cross-head brasses are being bored by the Bullard vertical turret lathe in the operation shown in Fig. 15, and in the same operation one end of the bore is rounded to a radius of about 1 inch. This cut is taken by a tool ground to the required profile, seen in the cutting position.

The fixture employed in this operation is of an ingenious design that insures machining of the bore closely in relation to previously drilled and bored bolt-holes. The two halves of the cross-head brasses are assembled together on mandrels that are slipped through the bolt-holes, a shim being placed between the two halves to provide for the proper fit of the brasses when assembled on the cross-head pin. The mandrels are made with a collar on one end, which is pulled against the brasses when a nut is tightened on a thread at the opposite end of the mandrel. The cylindrical ends of the mandrels are seated on hardened and ground blocks of the fixture, two of these blocks being made with vertical shoulders for locating purposes. The boring tool is Firthite-tipped, while the profile cutter is of Rex AAA high-speed steel. The brasses are bored to 7.500 inch within plus or minus 0.001 inch.

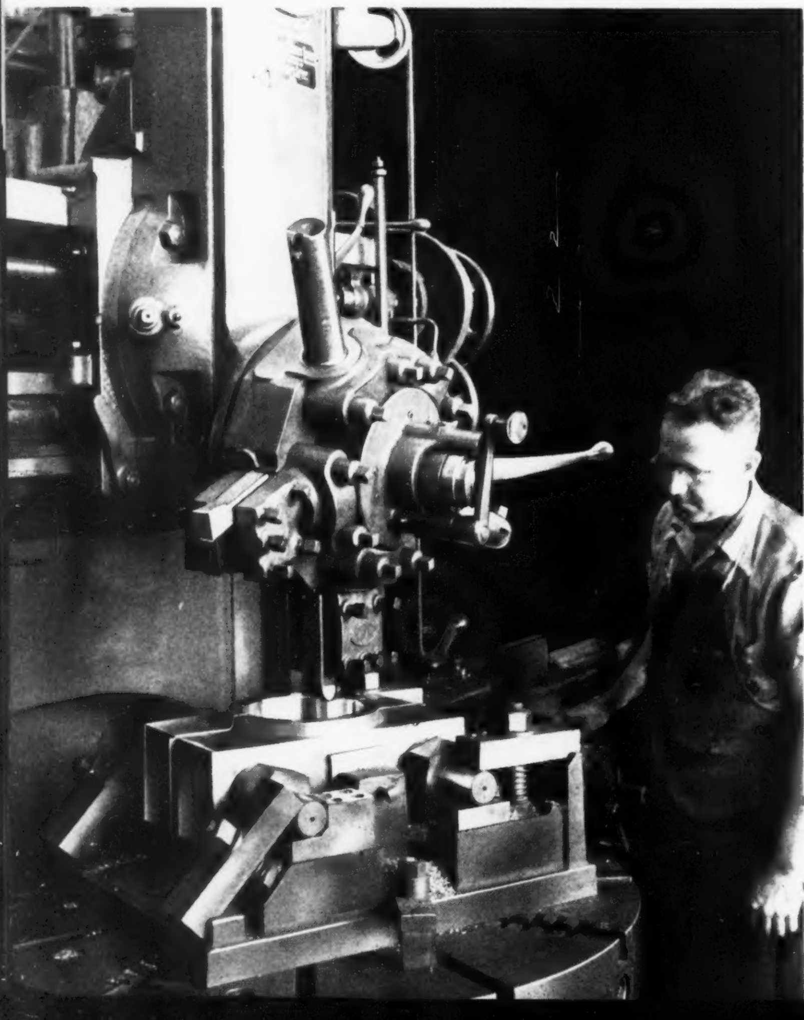


Fig. 15. Cross-head Brasses are Bored and One Corner is Rounded on a Vertical Turret Lathe Equipped with an Ingenious Work-holding Fixture

Fig. 16. Cutting the Bearing Cap from the End of a Valve Stem by Employing a Hydraulically Operated Sawing Machine

Cross-head blocks are bored straight and to a taper on a King vertical boring mill set up as shown in Fig. 14. In setting up the work, the truncheons which extend from each end of the cross-head block are located for height by means of hardened and ground blocks on the table, and then one end of the cross-head block is clamped to the vertical face of an angle type fixture.

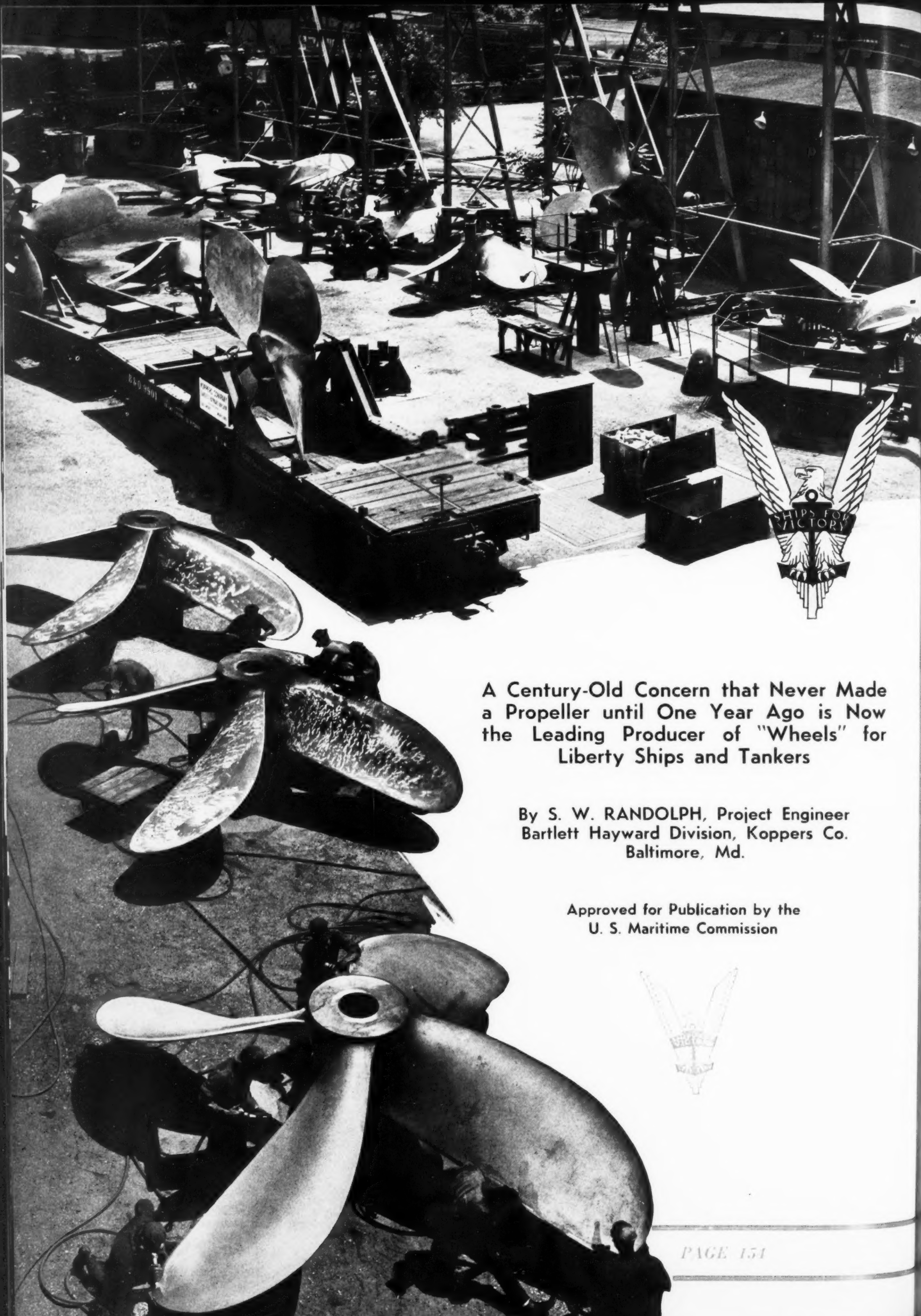
In the operation, the hole is bored straight through the cross-head block to a diameter of 5 1/16 inches, the block being 10 1/2 inches thick. Then the tool on the cross-rail head at the left, which has its ram set to the required angle, is fed downward into the bore of the work to machine the taper at the upper end. When finished, the maximum taper diameter is 6 1/4 inches and the taper intersects the straight bore 4 1/4 inches from the top of the cross-head block. The taper is machined to the plug gage seen lying on the table. The allowance between the upper end of the gage and a hardened and ground bar placed on top of the cross-head block when the gage has been inserted in the work, is only 0.003 inch.

The bearing cap is cut from valve stems in a rather unique manner after the stems have been turned and bored for the eccentric rod pin bearing. The valve stems are then brought to the Peerless hydraulic saw shown in Fig. 16, where the part is placed on the saw table with scribed lines on opposite sides of the bore lined up carefully with the saw blade. The operation is performed by feeding the saw through a 3 5/8-inch thickness. The bore is nominally 6 inches in diameter.

On the erection floor the three cylinders of these engines are set up on parallel blocks and assembled as one unit before being transferred to the top of the engine columns. The cylinder bores are accurately lined up, the top and bottom surfaces of the cylinders are checked for alignment, and all necessary corrections made before the cylinders are placed on the engine.

While all major parts for these engines are produced in the Hooven, Owens, Rentschler plant, many of the smaller parts, and especially the accessories, are purchased from other companies. Over one hundred firms supply parts.

In shipping the engines, the bed, main bearings, and crankshaft go out as one unit and the cylinders as another unit. Four flat railway cars are required to carry one engine.



A Century-Old Concern that Never Made a Propeller until One Year Ago is Now the Leading Producer of "Wheels" for Liberty Ships and Tankers

By S. W. RANDOLPH, Project Engineer
Bartlett Hayward Division, Koppers Co.
Baltimore, Md.

Approved for Publication by the
U. S. Maritime Commission

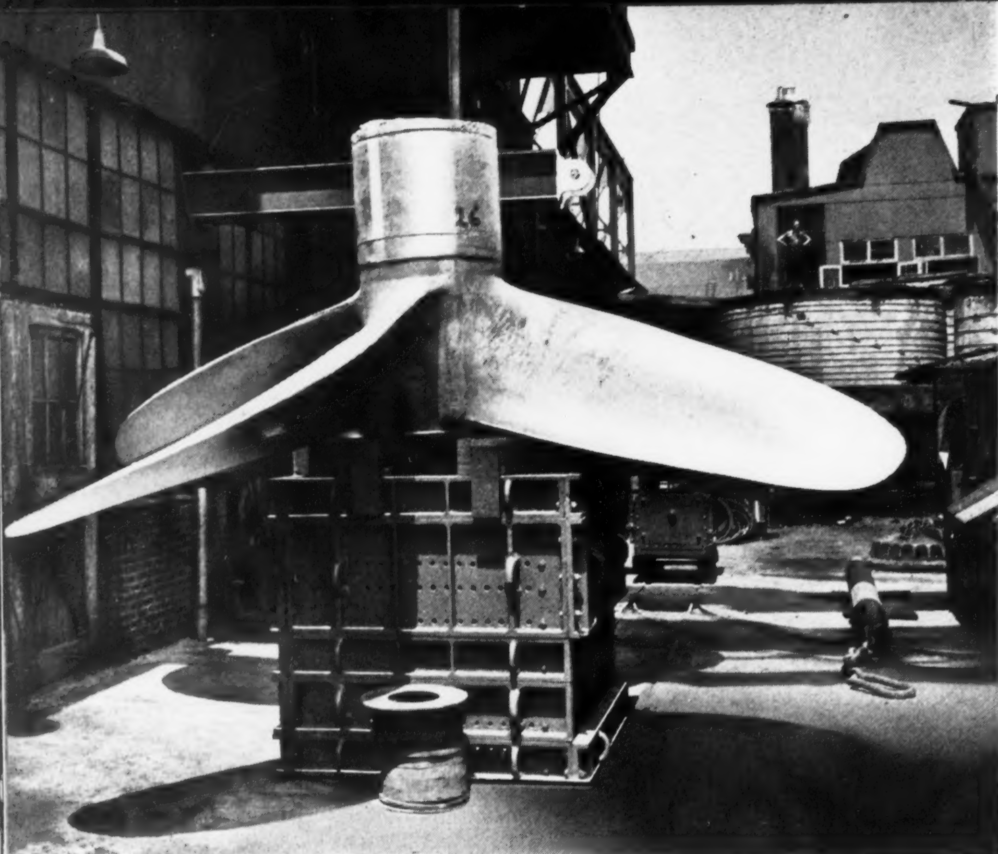
Koppers Propellers for Driving the Victory Merchant Fleet

AMERICAN industry has risen to great heights of achievement in turning out the products that are of vital importance in winning the war. Through sheer enterprise and ingenuity many industrial concerns have established remarkable records in manufacturing products that are entirely different from those they produced in normal times. An outstanding example is the Bartlett Hayward Division of Koppers Co., Baltimore, Md., which during the one hundred and ten years of its existence has built many metal products, ranging from cast-iron stoves to illuminating gas plants and sugar refineries, but had never produced a ship's propeller when it closed a contract with the United States Maritime Commission a little over one year ago. The management had anticipated that the demand for ship propellers would go far beyond the capacity of shops then in existence for that type of product. An order for seventy-seven propellers for Liberty ships was obtained without machining equipment on hand or even a suitable flask in the foundry.

The story from then on is typical of the achievements of concerns from coast to coast in carrying out the Maritime Commission's program. The Bartlett Hayward Division had a bronze foundry with a capacity for producing fairly large castings, but changes had to be made in the reverberatory furnace to enable bronze to be melted in a sufficiently large quantity for pouring a propeller from one heat, and special machinery had to be designed and built for handling propellers on a production basis. Time was not taken to erect a building for the machines required. They were set up outdoors without a roof overhead, and were soon placed in operation, although a temporary structure is now being erected over these machines in anticipation of the coming winter.

None of the key or shop men had experience in propeller manufacture, and consequently methods were developed from the ground up, as a result of which a considerable number of operations are original in their conception. Today, the concern is the biggest producer of Liberty propellers for the Maritime Commission's program, and it was the first enterprise to win the "M" award for propeller production. Since September last year, 240 propellers have been

Fig. 1. Pouring a Manganese-bronze Propeller for a Liberty Ship which, with Its Shrink-head, will have a Weight of 31,000 Pounds in the Rough



Koppers Propell[ers]

Fig. 2. Liberty Ship Propeller as it Comes from the Mold, Seen Resting on a Stand preparatory to being Turned over for the First Machining Operation

turned out, completely finished, and about a dozen and a half more have been cast, out of contracts calling for a total of 559 propellers for Liberty ships and 43 propellers for oil tankers. Seven propellers are being turned out per week, those for Liberty ships weighing 23,000 pounds, and those for tankers, 34,500 pounds. These propellers are both of four-blade design, and measure nearly 20 feet from tip to tip.

Propeller manufacture starts in the foundry, where six flasks are in continuous operation. The four-blade metal patterns are replicas of the propeller castings, except for the shrinkage allowance in the patterns. Each mold is made with a large pouring basin to one side at the top, as seen at *A* in Fig. 4, from which the molten metal flows downward through a gate *B* formed of hollow cores and tile. This gate leads to the bottom of the mold and connects at a point where the lower hub is formed. The cast propeller is indicated at *C*.

Cement is used in combination with sand in making up the molds, the proportion being approximately one part cement to eight parts sand. Rubble broken up from previous molds is used to form the bulk of the cope and drag filling, but the surfaces next to the pattern are, of course, made up from a new mixture. The mold is sufficiently permeable to allow gases to escape. The hub core *D* is made from the same cement and sand mixture as the mold.

The practice is to start making a mold at about 6:30 o'clock in the morning, and by 3:30 P.M. of the same day, three molders and three helpers have completed the job. The pattern is

Fig. 3. Method of Turning over a Heavy Propeller Casting so that the Shrink-head is Down, without Chance of Damaging the Propeller Blades

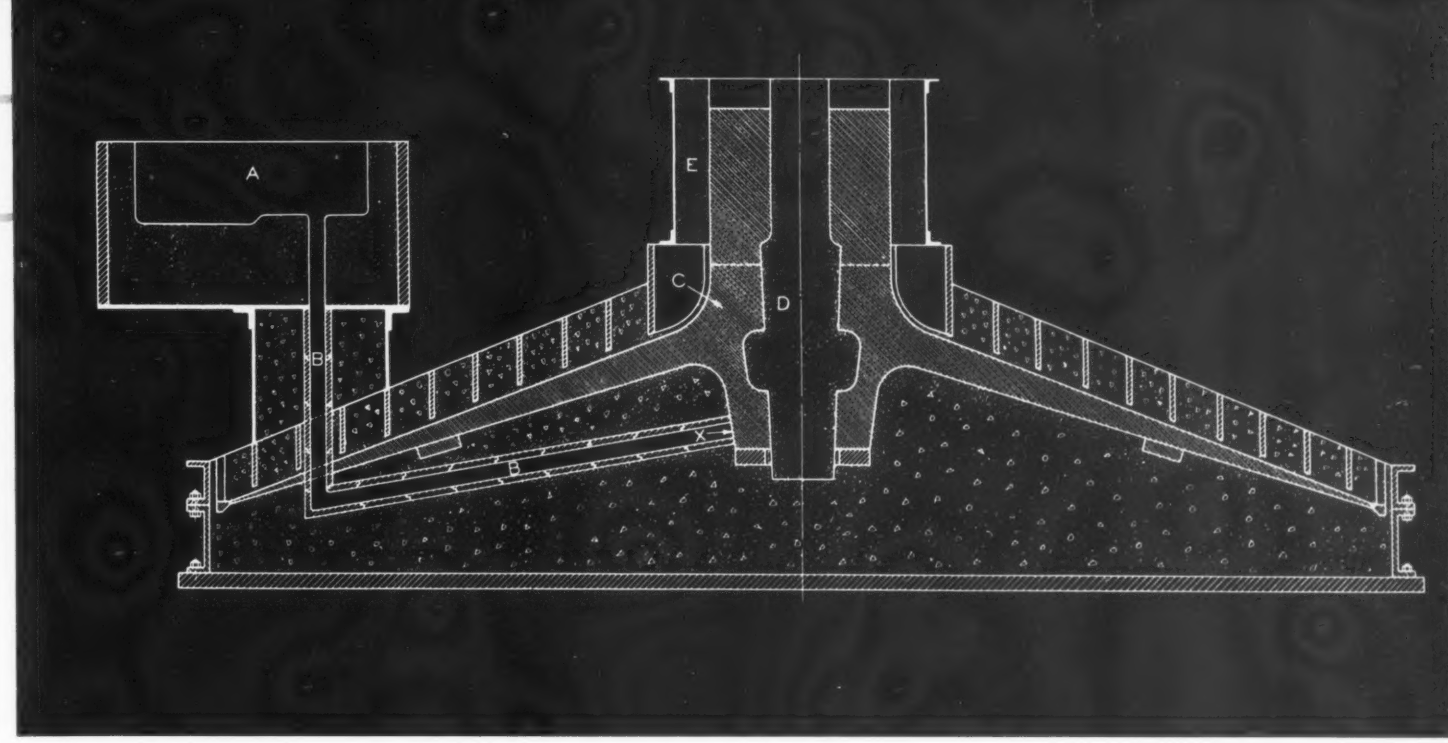


Fig. 4. Cross-sectional Drawing of a Propeller Mold, Showing Pouring Basin, Shrink-head, and Gate Arrangement

allowed to remain in the mold overnight. The next morning the copes are taken off and the pattern removed, after which the mold surfaces are dressed and blackened. The copes are then replaced on the drags and the mold is permitted to air-dry until night. Then a Maxon pre-mix gas burner is placed on top of the mold and hot air is directed into the mold through the hub and out through vents at the tips of the blades for a period of twelve hours so as to thoroughly dry all mold surfaces. The following morning the cores are set, and molten metal is poured into the mold to form the propeller.

These propellers are cast from a manganese-bronze mixture having a composition, roughly, of 58 per cent copper, 39 per cent zinc, 1 per cent iron, 1 per cent manganese, and 1 per cent aluminum. The mixture is melted in the reverberatory furnace, which is of a special cylindrical design more rigid in form yet simpler to construct than the conventional rectangular type. A spare furnace, completely lined, is kept ready to skid into position whenever a new lining is necessary. The change can be made in less than twenty-four hours without interrupting production. It is necessary to renew the lining about every one hundred heats. The furnace is operated at a temperature of approximately 1880 degrees F.

Molten metal is discharged from the reverberatory furnace to a ladle that holds sufficient metal for pouring one complete propeller. The ladle is transferred quickly to the mold by means of an overhead shop crane, and the propeller is poured in 3 1/2 minutes. In pouring, the metal flows down through the gate and rises

Fig. 5. Cutting the Shrink-head from a Propeller with Two Wide-faced Parting Tools Mounted on a Pot Casting that Revolves around the Stationary Propeller

gradually in the mold, first filling the bottom hub section, then flowing out to the extreme edges of the four pockets that form the blades, and finally rising through the top portion of the mold, which forms the upper hub. (Fig. 4 shows a cross-sectional drawing of the mold). Then the molten metal rises still further to fill a shrink-head *E* on top of the mold. All dross is skimmed from the molten metal at points opposite the four blade pockets of the mold as the level of molten metal rises.

This shrink-head is of unusually generous proportions because of the large amount of shrinkage that occurs during cooling. The surplus metal left on the casting from the shrink-head is 3 feet in diameter by 2 1/2 feet high. On a propeller for a Liberty ship, the shrink-head alone weighs approximately 6000 pounds, and on the propeller for an oil tanker, 11,000 pounds. In Fig. 1 the pouring basin is seen at the left, and the mold proper, with its shrink-head, at the extreme right. The hydrostatic pressure created in pouring is so great that it is necessary to securely key the hub core to the top of the mold prior to the operation.

After pouring, the propeller is left in the mold undisturbed until the following morning, when the upper section of the mold is removed to expose the shrink-head of the casting only. The next morning the propeller casting is shaken from the mold. With the shrink-head, the propeller casting for a Liberty ship weighs 31,000 pounds and for an oil tanker, 50,000 pounds.

The first operation after the propeller leaves the foundry is to cut off the shrink-head, but before this can be done, the heavy casting must be turned over, so that the shrink-head is on the under side instead of on top, as it was in the mold. While turning over a propeller may sound like a simple procedure, it is ordinarily a difficult operation, because of the danger of scarring the blades or damaging their tips by cutting or bending. At this plant a method was devised that enables the propellers to be turned over quickly and without danger of damage. When a propeller is taken from the foundry by an overhead crane, it is placed on a loading stand, built up, as seen in Fig. 2, from old foundry flasks. Then a bar is inserted through the cored hub and clamped against the faces of the hub to hold it in position. A pin inserted through one end of this bar is fitted to a shackle, and the shackle is attached to a chain suspended from an outdoor traveling crane.

The propeller is then raised by the hoist until a hole in the lower end of the bar can be lined up with corresponding holes in the outer end of a beam erected along the side of the foundry building, as shown in Fig. 3. Next, a pin is inserted through this beam and through the bar to which the propeller is attached. This provides a pivot point when the crane chain is slacked off, so that the propeller swings downward and is turned upside down. Chains are then swung around the blades for carrying the casting to the first machining operation.

This operation, which consists of cutting off the shrink-head, is performed on a special machine constructed around the table unit of a vertical boring mill. The machine, seen at the extreme right in the heading illustration, is provided with four concrete columns that are

Fig. 6. Applying a Portable Chipping Hammer for Decreasing the Thickness of a Propeller Blade along the Edge to Meet Specifications

spaced around the table unit. Cradles on top of these units support the four blades, each cradle being furnished with horizontal and vertical means of adjustment. On the machine table there is a hollow pot type casting which is equipped at the top with two tool-slides that can be fed radially by feed-screws operated by star-wheels. One of these slides is seen in Fig. 5.

The first step in the operation is to cut a groove about 1 1/2 inches wide around the shrink-head at a point several inches below what will be the hub face. This groove is cut by means of right-angle offset tools mounted in the two slides.

When this groove has been cut to a depth of about 1 1/2 inches, supporting brackets, such as seen in the center of the illustration, are inserted in the groove for the purpose of holding up the shrink-head when it has been cut off in the second step of the operation. These brackets revolve around the stationary work during the cutting off. For this step of the operation, the offset tools are replaced by wide, straight tools, such as seen in the illustration, which cut at a height several inches above the groove produced by the offset tools. In the case of both the offset and the straight sets of tools, one tool has a beveled cutting edge which hogs out the stock in the center of the groove, while the second tool is ground to remove stock in the groove corners. All the tools are tipped with tungsten carbide. The time consumed in cutting off the shrink-head from a Liberty ship propeller is about four hours, and from a tanker propeller, six hours. The feed of the tools per revolution around the propeller is 1/64 inch.

As the edges of the propeller blades cannot be cast as thin as specifications demand, it is necessary to chip them with pneumatic hammers in the manner illustrated in Fig. 6, which shows an Ingersoll-Rand chipping hammer being used. The propellers are then polished all over with portable pneumatic grinders. Cup emery wheels are used first, then disk wheels, and finally drum or cylindrical wheels of the type shown in Fig. 7. The portable tool in use in this illustration is a Rotor pneumatic grinder. Chipping, grinding, and polishing consume about 160 man-hours in the production time of each propeller.

After the propeller blades have been polished on the leading side, they are transferred to the Pitchometer illustrated in Fig. 8 for determining the exact center of the propeller with respect to the pitch of the blades. The propeller is seated on a base that can be tilted in any direction by means of screw jacks. Also, the center column of the machine, which carries a radial arm and pointer, is mounted on a slide that can be adjusted in any direction horizontally.

With the Pitchometer pointer positioned at a predetermined distance from the center of the column, it is repeatedly brought in contact with the blades at the same point on the four blades, and adjustments are made in the column and propeller settings until the height reading of the Pitchometer pointer is the same on all blades. The radial arm on which the Pitchometer pointer is mounted is graduated to enable accurate settings to be made along the arm, and the vertical slide to which the pointer is attached is also graduated. Around the column of the machine there is a jig drilled indexing plate

Fig. 7. Portable Pneumatic Tools are Employed to Polish the Propellers All over with Cup, Disk and Cylindrical Emery Wheels

Fig. 8. Pitchometer Used to Locate Identical Pitch Points on the Four Blades of a Propeller prior to Rough-balancing Operation

with bushings located 5 degrees apart. This enables seventy-two different settings of the radial arm to be made around the column. When the propeller has been finally set up in relation to its center, a definite pitch point is prick-punched on each blade.

If corrections are necessary in the leading faces of the blades, the propeller is returned to the chippers and grinders. Otherwise, the propeller is transferred to the static balancing stand shown in Fig. 9 for rough-balancing. First, however, an arbor for supporting the propeller during balancing is inserted through the hub, and screw-heads are adjusted radially to position and clamp the arbor in the cored hub. The balancing arbor is then shifted to a horizontal position by means of the traveling crane, and placed on the rollers of the balancing stand as shown.

The propeller is indexed on this stand to determine the position of the pitch prick-punch marks with respect to a pointer mounted on the column of the balancing stand. The position of the arbor is then adjusted as required until the pointer touches each punch-mark, which indicates that the center of symmetry has been determined. Static balance is then checked, and corrections are made by shifting the position of the arbor in the propeller hub. When balance has been attained, the propeller is returned to the Pitchometer, where it is marked up for a new center based on the static balance. The propeller is then again returned to the grinders for making corrections and finishing the blades, upon the completion of which the balance is again checked.

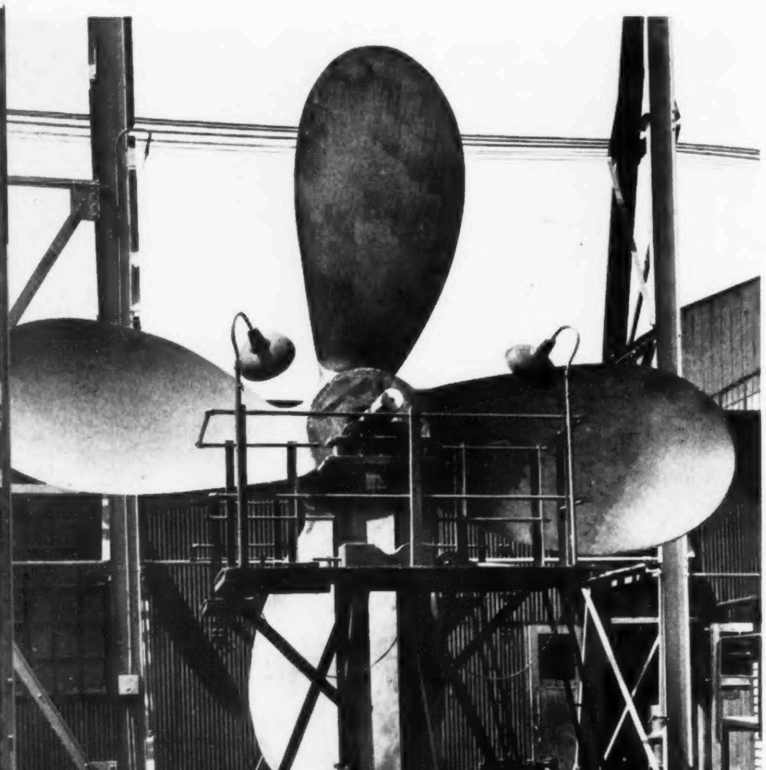


Fig. 9. Balancing Stand on which Propellers are Mounted for the Performance of Several Static Balancing Inspections

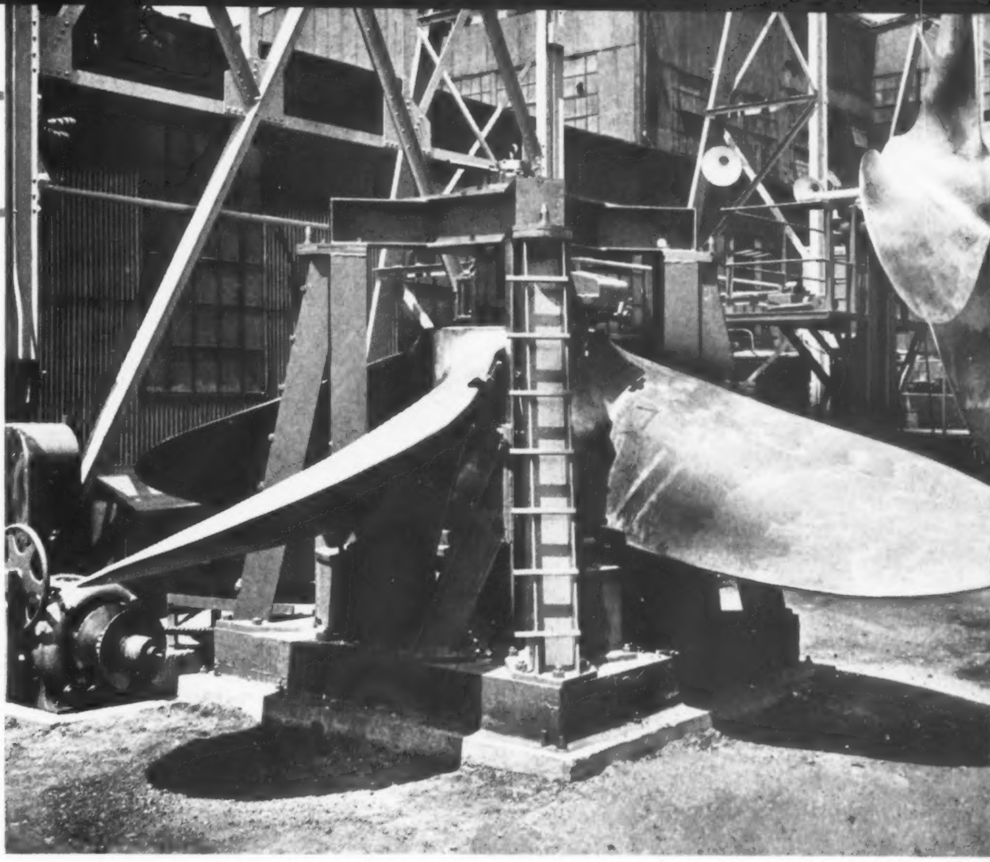


Fig. 10. Special Machine Employed for Boring and Facing the Propeller Hubs, the Upper Facing Head being Shown in Use

The next operation—boring the hub—is performed in the special machine shown in Fig. 10, which is provided with a removable cross-head at the top for supporting the boring-bar. The lower end of the boring-bar is made to fit a sleeve that is worm-driven from a motor through a Reeves speed reduction unit, which enables the tool-bar to be operated at various speeds. The boring-bar is provided with an integral roller bearing unit at the top which fits a counterbore in the cross-head.

The propeller is taken to this machine with the rough-balancing arbor still in place, and positioned, as previously described, in accordance with the centers of symmetry and rough balance. It is brought to the machine by the overhead crane and lowered carefully in such a position that the bottom end of the arbor will enter the machine sleeve. The cross-head is then placed on the machine, and the upper end of the arbor is properly centered by adjusting screws under the blades. Next, supports are adjusted beneath the propeller blades, and clamps are tightened to hold the propeller securely in position when the arbor is withdrawn and the boring-bar placed in the machine.

From the close-up view of this machine in Fig. 11, it will be seen that the boring-bar is provided with a star-feed, the star-wheel striking a vertical kicker pin at each revolution of the bar within the propeller hub. Since the hub must be bored to a taper, the tool-slide is mounted on a dovetailed way, the top surface of which is ground to an angle with the center line of the bar that corresponds with the speci-

Fig. 11. Close-up View of the Boring and Facing Machine, Showing the Machine Set up for Taper-boring the Hub

fied hub taper. Thus, the slide recedes radially as it is fed down the bar. The hub is machined to such accuracy that no scraping is necessary.

A lead tool that removes any lumpy surfaces ahead of the rough-boring tool may be seen at the bottom end of the slide in Fig. 11, while the actual boring tool projects from the side of the slide. A roughing cut 7/8 inch deep is taken with a feed of 1/32 inch, which is one of the reasons why high production is possible. There is 0.040 inch of stock left after rough-boring to be removed by the finishing cut. When the boring slide is at the bottom of the bar, it is retracted by an air motor on top of the machine.

When boring has been completed, a conventional plug gage, supplied by the Maritime Commission, that conforms to the shape of the bore for its entire length, is used for inspection purposes. Bluing applied to the gage indicates any high spots. The top of this gage must be in the same plane as a scribed line on the hub which indicates the proper location of the finished hub face. This line was scribed in relation to the rake of the blades while the propeller was on the balancing stand.

When the hub has been bored to meet specifications, the boring-bar is removed and a bar substituted to which radial arms can be attached, both above and below the propeller, to accommodate facing slides. First the top face of the hub is finished, and then the bottom face. These facing slides, the upper one of which can be seen in Fig. 10, are also provided with starfeeds which engage horizontal kicker pins at each revolution of the facing bar for feeding the tools across the hub faces.

The top face of the hub is also counterbored while the propeller is in this machine by attaching a form cutter to the clamping cap of the top facing arm. A simple counterbore is machined in propellers for Liberty ships, but a three-step counterbore is required on propellers for oil tankers. The boring, facing, and counterboring of a Liberty propeller takes sixteen hours.

Tallow holes are next drilled through the hub at four points to lightening pockets cast in the inside of the hub. This drilling is accomplished by mounting an air drill horizontally on a stand, as shown in Fig. 12, the stand being equipped with a screw for feeding the drilling unit toward the propeller. A two-fluted drill is used.

The propeller is next turned over with a finish turnover arbor, which fits the hub bore, and a keyway is laid out on the top face of the propeller hub. Twelve holes located from this keyway are then drilled in the hub face and tapped to receive studs for a fairwater cap. This operation is performed under the Cincinnati Bickford radial drilling machine shown in Fig. 13. A circular drill jig insures accurate center-to-center distances of all stud-holes. The under side of the jig used for Liberty ship propellers

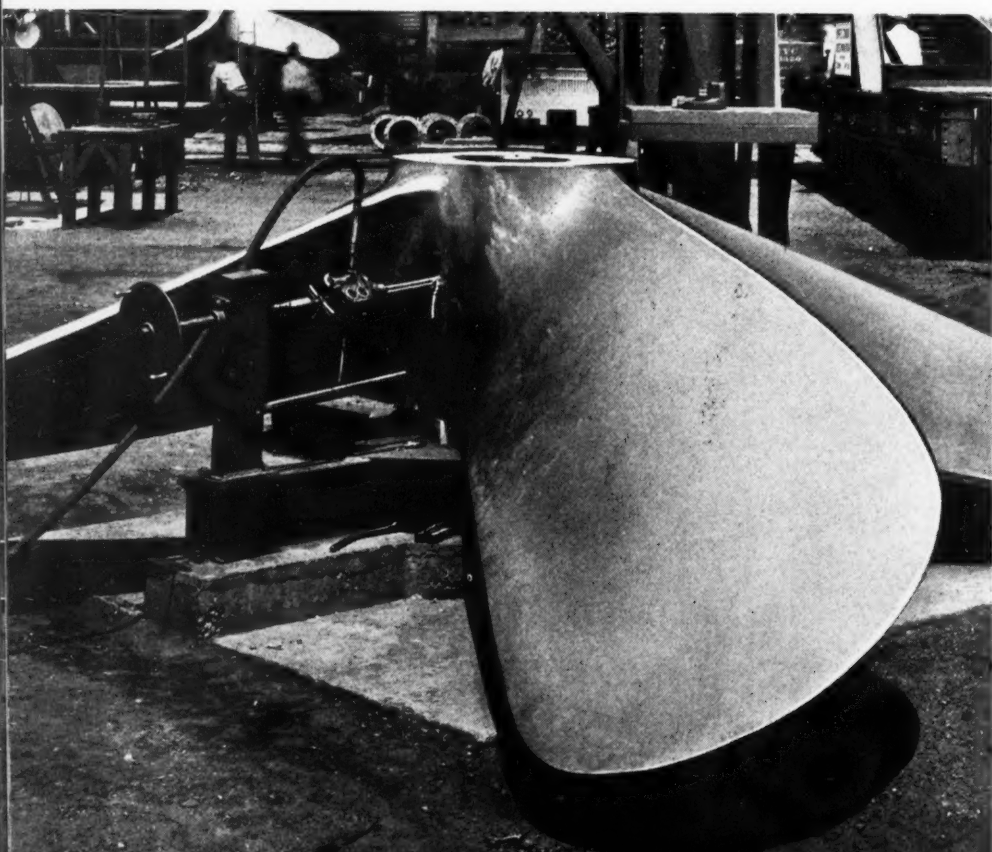


Fig. 12. Special Stand and Feeding Arrangement Employed in Drilling the Four Tallow Holes through the Hub of the Propeller

is similar in design to a universal lathe chuck in that it is provided with fingers that can be expanded radially by the operation of a nut-head. In this way, the fingers can be made to engage the small end of the tapered hub bore and insure accurate centering of the jig. As propellers for oil tankers are made with a raised shoulder on the hub face, the drill jig used for those propellers is simply counterbored to fit the shoulder. In the case of tanker propellers, the opposite hub face is also drilled and tapped to accommodate studs for a gland. Two 2 1/4-inch jack bolt-holes are also drilled and tapped in the aft end of both Liberty and tanker hubs.

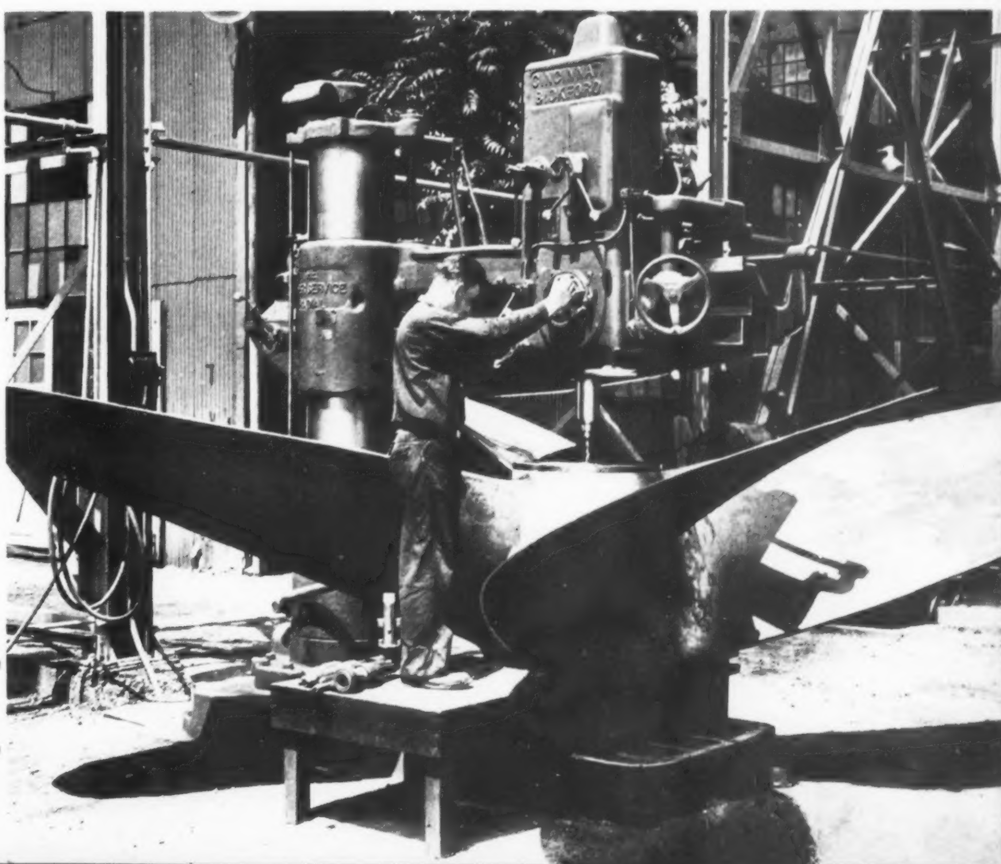
The next operation on the propellers consists of cutting the keyway; it is performed on a Mitts & Merrill keyseater equipped with a special fixture designed to fit the tapered propeller bore and also to support the vertical ram of the machine. To enable the propeller to be dropped vertically on the machine, the latter is tilted so that the keyseating ram is parallel to the taper of the bore.

The fairwater cap is next assembled to the aft face of the propeller hub, and the joint between this cap and the hub is chipped and ground to a smooth joint.

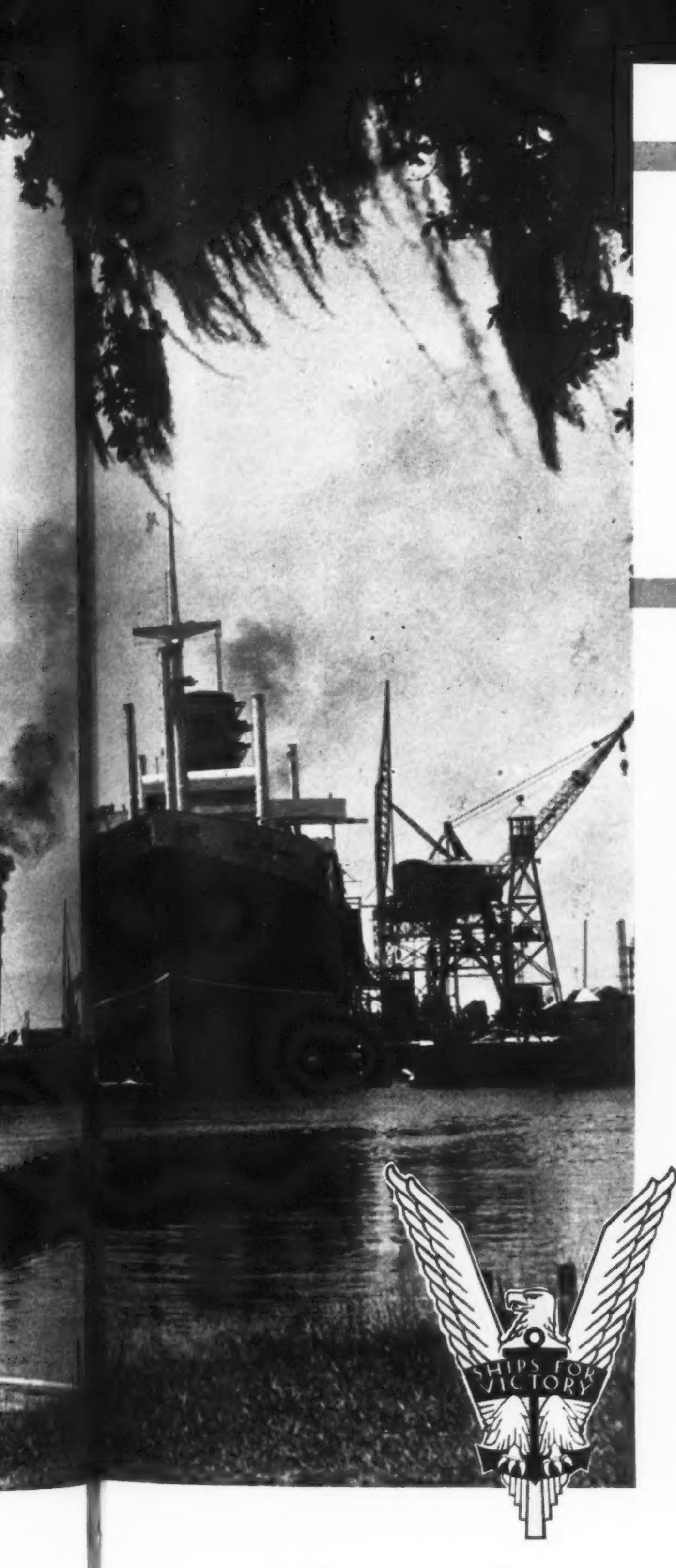
The propeller is now ready for final balancing, after which it is turned over to the resident Maritime Commission inspector for complete checking. For final checking of the static balance, the propeller is mounted on a spool machined to fit the bore of the propeller hub, and a straight arbor is inserted through the spool for supporting the propeller on the balancing stand. The contour of the blades is checked at points 12 inches apart along the full blade length, and the thickness at these points is also inspected. Incidentally, the maximum thickness of the blades on a Liberty ship propeller is 7.18 inches, and on an oil tanker propeller, 8.80 inches.

Propellers produced by the Bartlett Hayward plant have been sent to shipyards on the Atlantic, Pacific and Gulf coasts. As it is highly important to prevent damage during transit, special methods have been developed to insure safe transportation. Tanker propellers are shipped on low-well cars which are built with an extra-deep bottom. Brackets have been erected on each side of these cars, as seen in the heading illustration, to support a shipping arbor which fits the bore of the hub and projects through the hub at each end. In this way, the propeller blades are prevented from coming in contact with anything during shipment. Shackles fastened to the arbor are provided for lifting the propellers on and off the cars by means of cranes. Propellers for Liberty ships are mounted two on a car on special cradles that also permit convenient unloading without damage when the propellers reach their destination.

Fig. 13. Drilling the Fairwater Stud Holes in One Propeller Hub Face prior to Tapping the Holes on the Same Machine



Busy Shipyards that Rim the Gulf of Mexico from Florida to Texas are Turning out Ships in Large Numbers to Defeat the Axis—This Article Describes Production Methods Employed by the Ingalls Shipbuilding Corporation, which Builds Vessels of 17,600 Tons Total Displacement without Driving a Single Rivet



The Deep South Turns to Shipbuilding

By ROBERT H. MACY
Chief of Planning and Estimating Departments, The Ingalls Shipbuilding Corporation, Pascagoula, Miss.

Approved for Publication by the U. S. Maritime Commission

THE vital need for cargo-carrying and other ships to meet losses due to enemy action has brought a huge new industry to our Southern states. Shipyards now rim the Gulf of Mexico from Florida to Texas, where formerly wild oak and Spanish moss grew unmolested. One of the most important of these shipyards is that of the Ingalls Shipbuilding Corporation, which was established at Pascagoula, Miss., in 1939. This is an ideal situation from the standpoints of proximity to raw materials, abundance of inexpensive labor, and favorable climatic conditions, which enable work to be carried on outdoors the year around.

The primary reason for the selection of Pascagoula as the site for the shipyard was its closeness (350 miles) to the city of Birmingham where the plant of the Ingalls Iron Works, parent company of the shipbuilding corporation, is located. The original plan was to fabricate practically all ship structural sections in as large units as possible in the Birmingham plant and transport them by rail and truck to the shipyard, which would be primarily an assembly yard. Since most of the steel plate and structural shapes used by the yard are rolled in Birmingham steel mills, which use iron ore mined in the surrounding mountains, this plan has been carried out with economy and complete satisfaction. Shipping difficulties have increased somewhat with the heavy war traffic, but since Birmingham is located on a river that empties into the Gulf, it is also possible to transport materials to the shipyard by water, and this facility is likely to be expanded considerably in the future.

Approximately 80 per cent of the steel that goes into Ingalls ships is cut to the required outlines and prefabricated in the Birmingham plant. Fabricated parts that are as high as 14

Fig. 1. Manual and Automatic Machine Welding are Used Exclusively for the Fabrication of Ingalls Ships. There is not a Single Rivet in One of These 17,600-ton Vessels

The Deep South Turns

feet above the floor of a car can be shipped by train. Sections of maximum height can be as wide as approximately 4 feet.

When sub-assemblies reach the shipyard, they are taken to outdoor platens that are located adjacent to the shipways and there fabricated into inner bottom sections, bulkheads, hatches, stacks, and other units, which are carried to the shipways by huge gantry cranes and placed in position aboard ship. Forty per cent of the steel necessary for a ship is fabricated before the keel is laid. This plan has eliminated expensive delays on vessels in course of construction. There are ten ways in this shipyard, and there are outfitting dock facilities for seven more vessels, making this the largest shipyard on the Gulf Coast.

The ships built in the Ingalls yard are the large, fast steam-turbine driven vessels known as the C-3, which are designed for permanent service in the merchant marine of postwar days, as well as for the needs of today. While these vessels are built primarily for use in carrying cargo across seas, they can readily be converted into auxiliaries for the armed forces, and it is anticipated that after the war many of them will be changed into combination passenger and cargo ships. These vessels have a total displacement of 17,600 tons, an over-all length of 492 feet, a molded breadth of 69 feet 6 inches, and a molded depth of 42 feet 6 inches. The main engine consists of one cross-compound steam-

Fig. 2. Three Torches, Mounted on Oxy-acetylene Cutting Heads, Simultaneously Cut Plates to the Required Width and Bevel Edges

a Shipbuilding

turbine unit having one high-pressure and one low-pressure turbine connected to the propeller shafting through double-reduction gearing. These vessels have a value of approximately $3,216,000, in comparison with an estimated cost of $1,800,000 for the 10,500-ton Liberty ships.

One of the features of these C-3 vessels, in addition to their exceptionally graceful lines, is the fact that they are constructed entirely by welding; there is not a single rivet in the ship. The only fastenings other than weld metal are the inevitable bolted connections that are necessary for attaching portable portions of the structure. The Ingalls Shipbuilding Corporation has on order at the present time forty-two of these vessels.

Electric arc welding by manually operated equipment is employed mainly for the fabrication of sub-assemblies, especially units comprised of plates that must be welded at right angles to each other. Fig. 1 shows a typical operation in the Birmingham plant, in which horizontal welding of vertical plates is accomplished by placing the section in an approximately upright position against structural braces that are welded to steel floor-plates.

Automatic Unionmelt welding machines are largely used for operations where plates are butt-welded together, as for example, the bottom shell, tops of inner bottom sections and deck plates. Most of this work is done right on the shipways. Several hundred single-operator, di-

Fig. 3. Typical Operation on a Vertical Bending Press that Mechanically Develops a Force of About 300 Tons for Bending Plates and Shapes to Required Outlines

Fig. 4. Spot-welding Operation which has Effected Great Time Savings in the Production of Wire-mesh Bulkheads

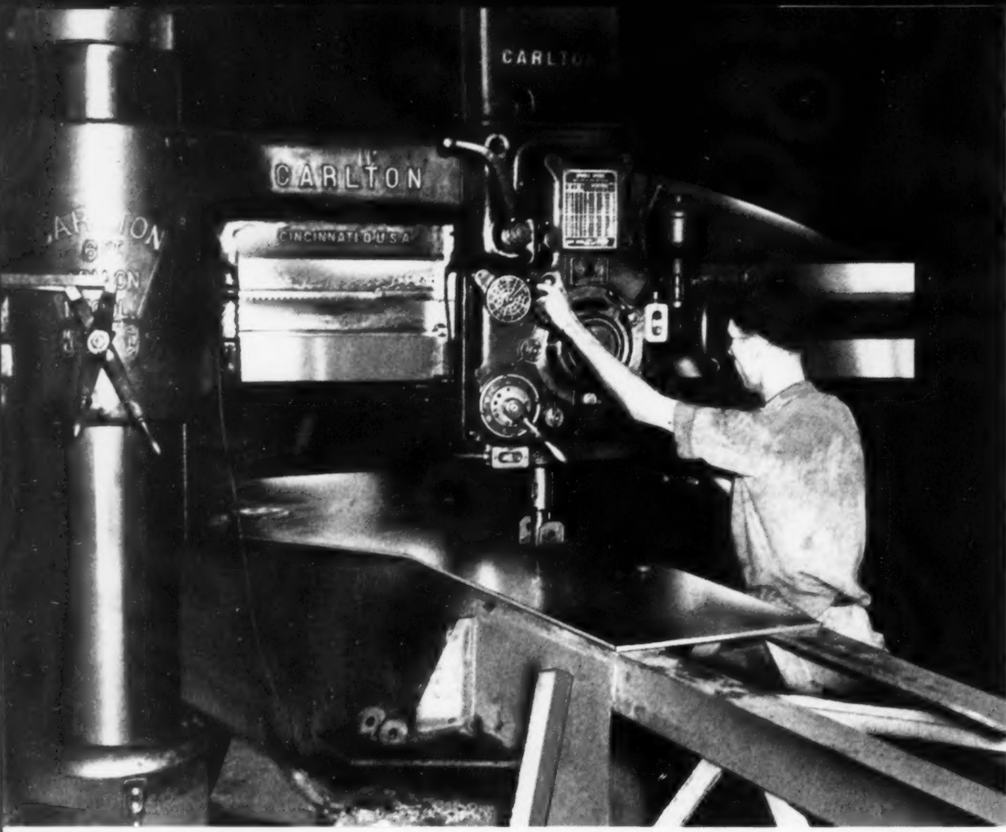


Fig. 5. A Line-boring Operation being Performed on a Large Ship Boom by Means of a Radial Drilling Machine

rect-current welding machines are in use at the Pascagoula yard, and in addition, there are a number of constant-potential, multiple-operator machines, each of which supplies current for use by as many as fifty welders at one time.

Automatic oxy-acetylene cutting machines are used to prepare plates and shapes for welding. Practically all plates are welded on both sides along the edges. Cutting of the plates to the required width and the beveling of both sides are accomplished at one time through the use of No. 10 Radiagraph cutting machines that are equipped with three torches, as illustrated in Fig. 2, instead of one torch, as in conventional practice. The torches are provided with Airco high-pressure Style 45 tips, which enable twice the ordinary cutting speed to be used. Edge surfaces are obtained as smooth and clean as on plates machined on an edge planer. Plates 5/8 inch thick are cut at a speed of approximately 24 inches a minute. The two extra torches are mounted on the cutting machines by means of a flat bar bracket.

In Fig. 3 is shown a vertical bending press which develops a force of about 300 tons mechanically for bending plates and shapes to required outlines. The part being bent is a brow plate for a hatch opening. Large tank heads,

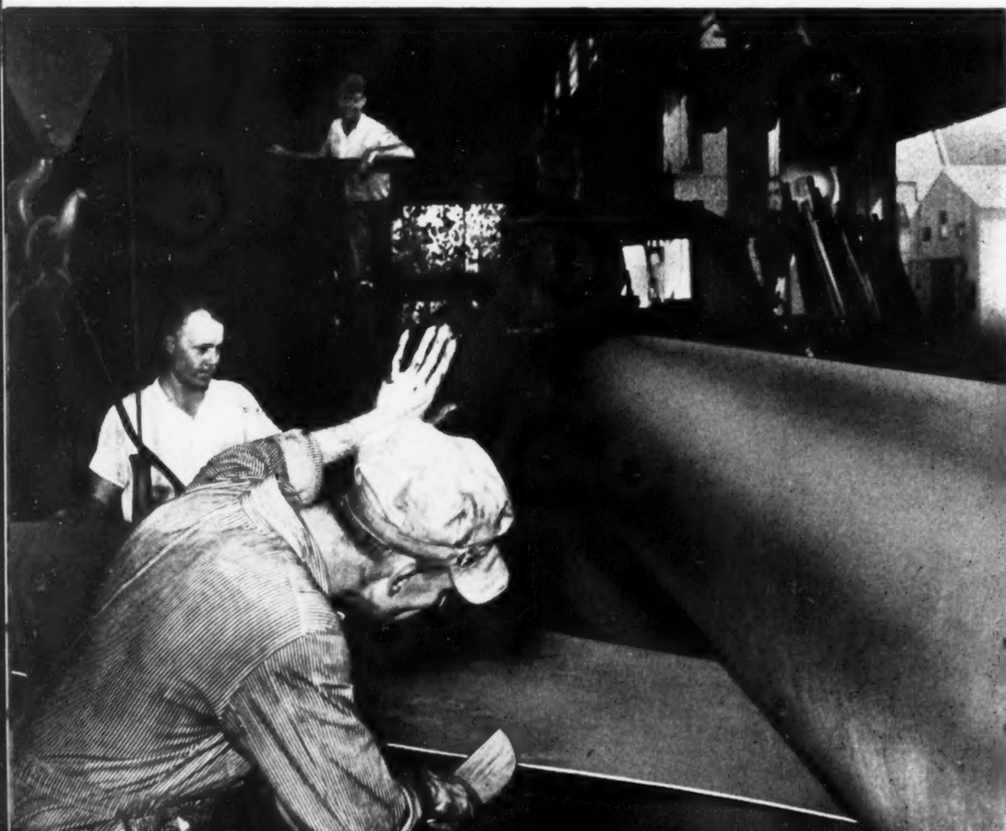


Fig. 6. Straightening a Plate between Rolls prior to Fabrication into a Ship Section

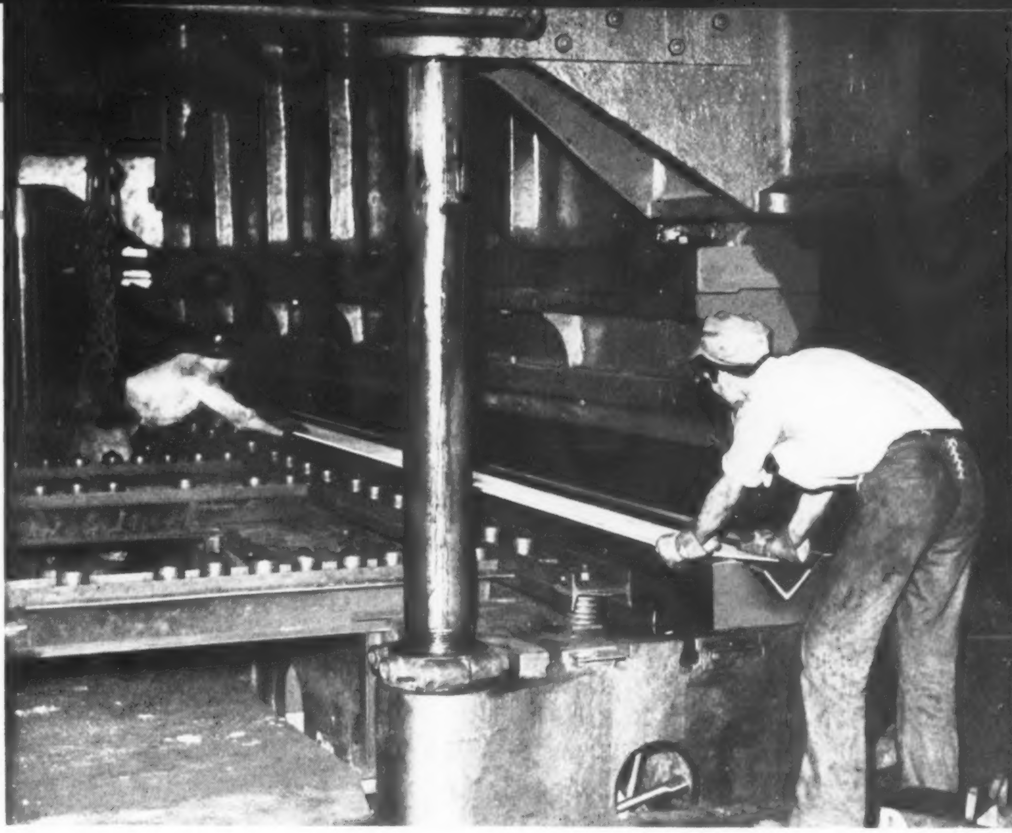


Fig. 7. Hydraulic Press with a 25-foot Ram Used for Bending Keel Plates and Similar Sections in a Long Straight Line

10 feet in diameter and 7/8 inch thick, are dished by this machine to a depth of about 28 inches and to a radius of 10 feet. Angle-irons welded to the bolster of the machine form the bottom die. This machine has a throat 7 feet 6 inches deep, and the stroke of the ram is 3 inches.

In Fig. 4 is shown a Thomson-Gibb spot-welding machine being used for welding woven grating to angle-irons to form wire-mesh bulkheads. Spot-welds are made from 5 to 6 inches apart all around the four sides of the bulkheads. The electrodes are about 3/4 inch in diameter at the point end. The upper electrode-holder is mounted in a ram which is operated vertically by means of a Logan air cylinder. The bulkheads, which are 7 feet long by 3 1/2 feet wide, are turned out by this method at a vastly greater production rate than was possible when the welding was done by manual equipment.

A boom for installation aboard ship is seen in Fig. 5 being drilled beneath a Carlton 6-foot radial drilling machine equipped with a work-table 34 feet in length. This table is provided with wheels which run along three tracks embedded in the floor for a distance of 80 feet. The boom seen on the table is 40 feet long. At the time that the photograph was taken, the op-

Fig. 8. Typical Operation in Bending the Miles of Pipe Required Aboard Ship

eration consisted of boring four holes in line to diameters of 4 9/32 and 4 1/2 inches. Quite a number of holes were drilled in the boom from 5/8 inch to 3 inches diameter, and some of them were bored to diameters as large as 6 inches. Angle-iron braces were welded both to the boom and to the table for supporting the work. They were cut off at the end of the operation.

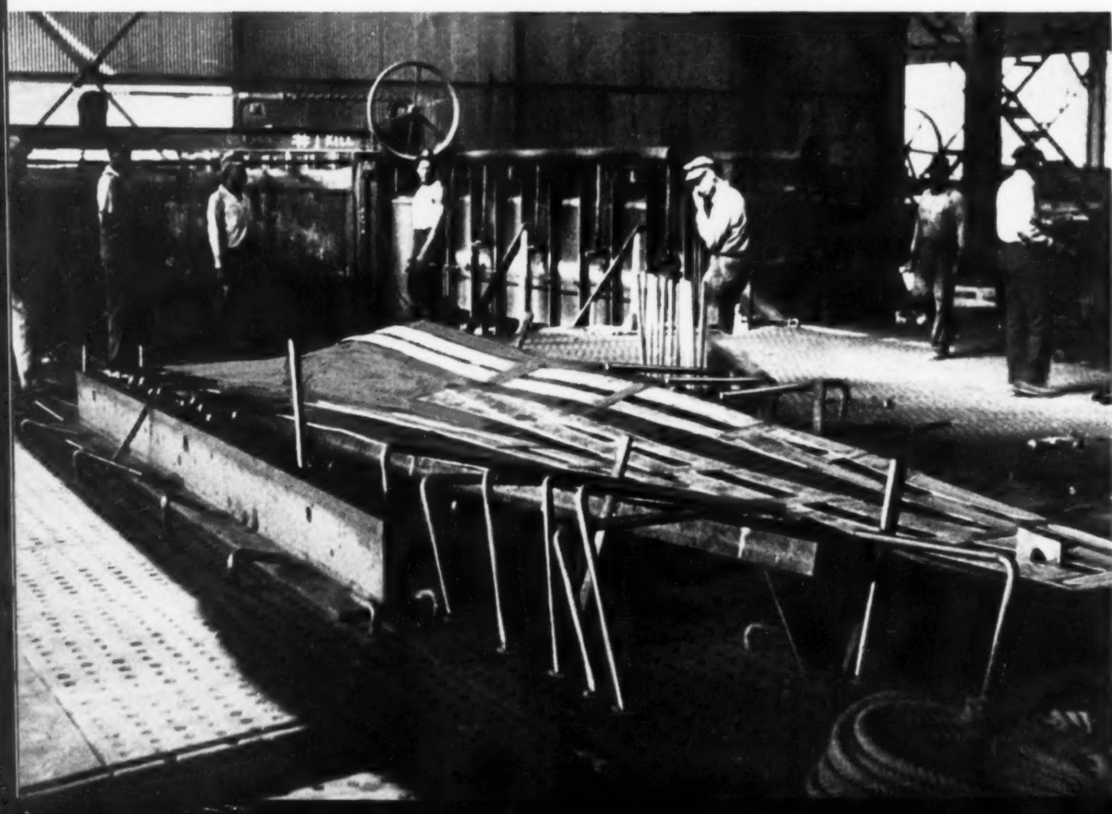
In this shipyard, plates are straightened prior to fabrication on the large Hilles & Jones rolls illustrated in Fig. 6, which have a capacity for plates up to 30 feet long by 1 inch thick. The upper roll of this machine is about 30 inches in diameter, and the two bottom rolls 24 inches in diameter.

Large plates are shaped to required forms by first heating them in oil-fired furnaces, and then laying them on metal forms set up on bending slabs, as shown in Fig. 9. Each plate, by its own weight, and by the application of sledge hammers, gradually assumes the shape of the form on which it has been placed, and is finally clamped to the form, as shown, until the plate has cooled and permanently taken on the required contour.

In Fig. 7 is shown a large Wood hydraulic press that is used for bending keel and other long plates in a straight line. This machine has a ram 25 feet long.

The bending of frame structural members, such as beams, channels, and angle-irons, which are ordinarily bent to templets on floor slabs by

Fig. 9. General View of a Furnace and Bending Slab with a Form Set-up, on which a Plate is Shaped to an Irregular Contour



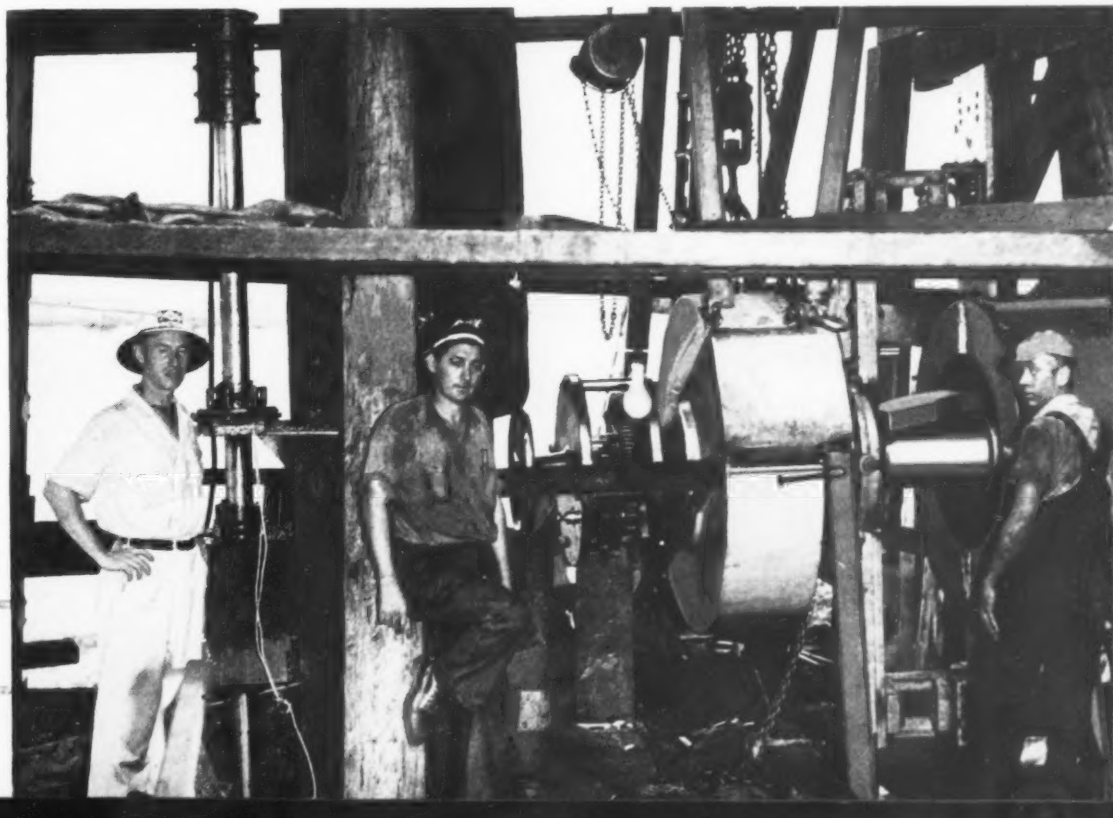
applying sledge hammers after the shapes have been heated, are now quickly formed to the required shapes by the use of a portable air-operated ram. This ram directs heavy blows in rapid succession against the shape being bent and eliminates the necessity of men employing sledge hammers. It saves at least 30 per cent of the time ordinarily consumed in operations of this type.

In Fig. 8 is seen a Pedrick pipe-bender being employed on a typical operation. Pipe up to 6 inches in diameter can be bent to any required multiple number of turns with this equipment.

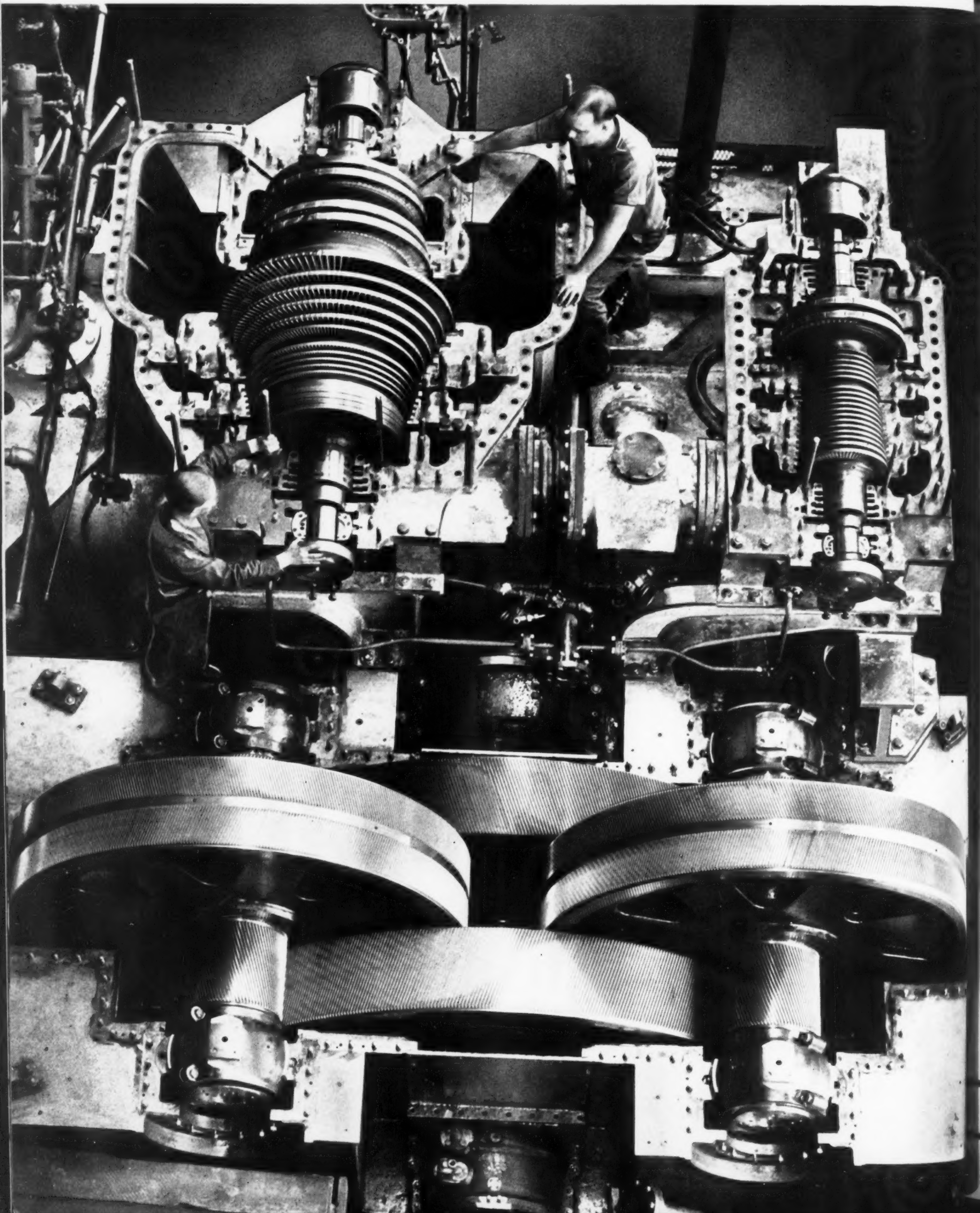
Aside from the hulls and masts, most of the units that go into Ingalls vessels are produced by outside concerns, so that an extensive machine shop is not necessary at the shipyard. An interesting operation, however, consists of finish-boring the stern frame to receive the propeller shaft. This operation must be performed when the ship is about ready for launching, and is, in fact, one of the last operations performed while the ship is still on the ways. This late machining is necessary because of the fact that welding changes the shape of a vessel.

The finish-boring of the propeller bearing in the stern frame is performed with a portable unit, as shown at the right in Fig. 10. At the same time that this operation is going on, the rudderstock is finish-bored in the stern frame by means of a boring-bar used in a vertical position, as seen at the left of the illustration.

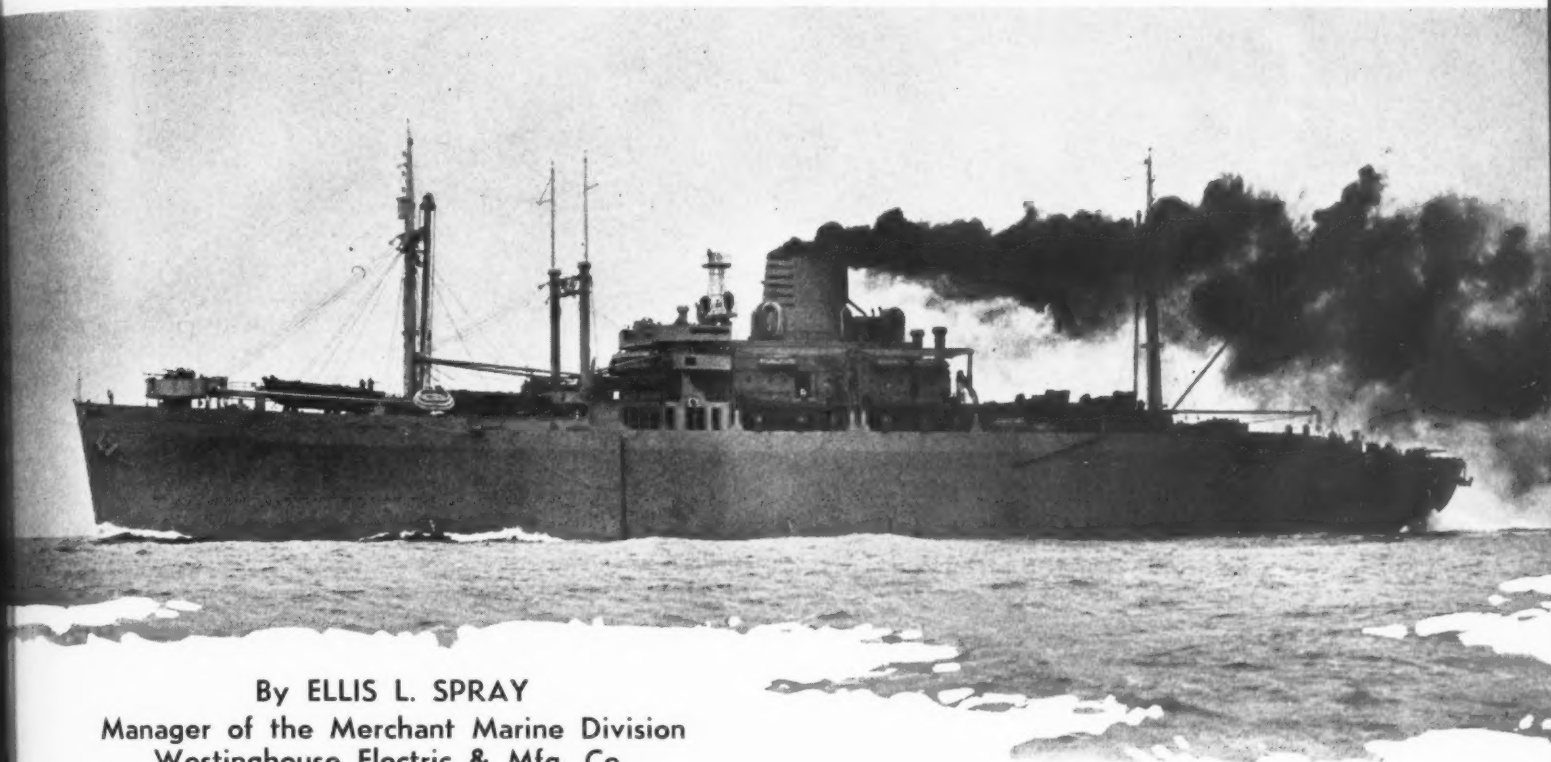
Fig. 10. Finish-boring Operations on the Stern Frame for the Propeller Shaft and the Rudderstock Journals



Building Turbines for Ships in



Our Permanent Merchant Fleet



By ELLIS L. SPRAY
Manager of the Merchant Marine Division
Westinghouse Electric & Mfg. Co.

Greatly Expanded Facilities for Building Propulsion Equipment are being Provided to Meet the Needs of America's Permanent Merchant Fleet. In a New Westinghouse Plant, $17,000,000 Worth of Machine Tools and Other Equipment has been Installed to Produce Turbines and Gears for Standard Type Merchant Ships at an Unprecedented Rate

Approved for Publication by the U. S. Maritime Commission

THE largest plant in the world devoted exclusively to the manufacture of propulsion equipment for merchant ships went into production early this year. Located "somewhere in the east," this new unit of the Westinghouse Electric & Mfg. Co. has been completely tooled and equipped to turn out marine turbines and gears in quantities never before achieved by any single plant. The turbine units being built conform to the Maritime Commission designs delivering 4000, 8500, and 9000 shaft horsepower, respectively. All three turbine units are of the cross-compound, impulse-reaction type, with a two-stage impulse astern turbine incorporated in the exhaust end of the ahead low-pressure turbine. These turbines and gears are to be installed in standard type merchant ships designed under the Maritime Commission's long-range program.

Because this plant has been designed and built to manufacture turbine units in only three sizes, specialized production tools and fixtures are being employed in nearly all operations to a far greater extent than has heretofore been believed practicable in turbine manufacture. Another feature of the shop is the huge size of many of the machine tools, including planers with tables 16 feet wide and 30 feet long, bor-

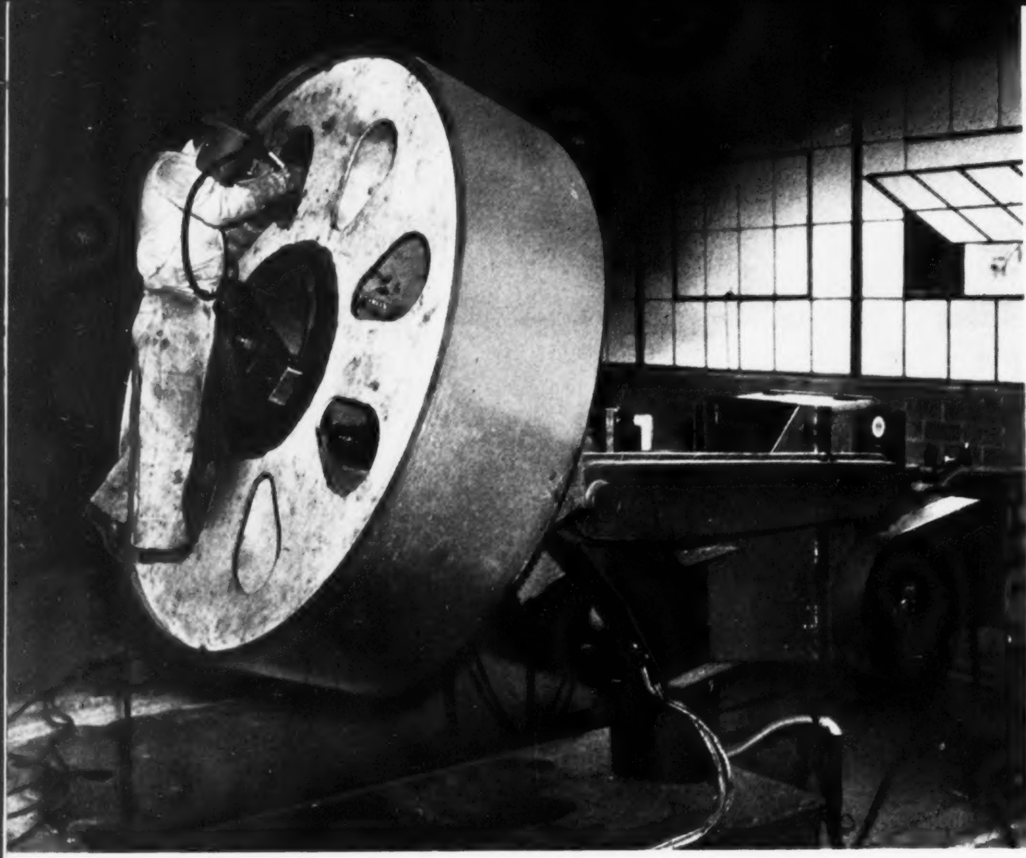


Fig. 1. Welding Interior Radial Ribs to Rim and Hub of Large High-speed Gear Blank. Fabricated Construction has Reduced the Weight of Turbine Gears Considerably, Compared with Former Cast Gears

ing mills with 18-foot diameter tables, lathes that will turn 200-inch gears, and hobbing machines that will cut teeth in gears 160 inches in diameter. Further indications of their size and specialized nature can be gained from the fact that forty-five of the machine tools cost more than \$50,000 apiece and six of these cost \$200,000 each. All together, over \$17,000,000 was spent for machine tools and other equipment.

Operations on some of these large machine tools, as well as other interesting steps in the production of marine turbines and gears for units similar to that shown in the illustration on page 172, will be described in this article.

Of particular interest are the helical gears used in the gear reduction unit. Large gears are needed, since the horsepower to be transmitted is considerable and the speed reduction ratio is great, the high-pressure turbine operating at approximately 5400 R.P.M., and the low-pressure turbine at 4500 R.P.M., while the propeller shaft rotates at a speed of only 85 to 90 R.P.M. The largest gear built in the plant is the so-called "bull wheel" for a 9000-H.P. turbine unit similar to that shown in the heading illustration, which has a pitch diameter of 146 inches and a total face width of 37 inches. Each of the helices of this gear has 693 teeth.

Fig. 2. Turning 75 1/2-inch Diameter Fabricated Gear Blank on 200-inch Lathe. About 86 Hours is Required to Finish-turn, Face, Groove, Chamfer, and Turn the Radius. Gears up to 146 Inches in Diameter are Used in Marine Turbine Units

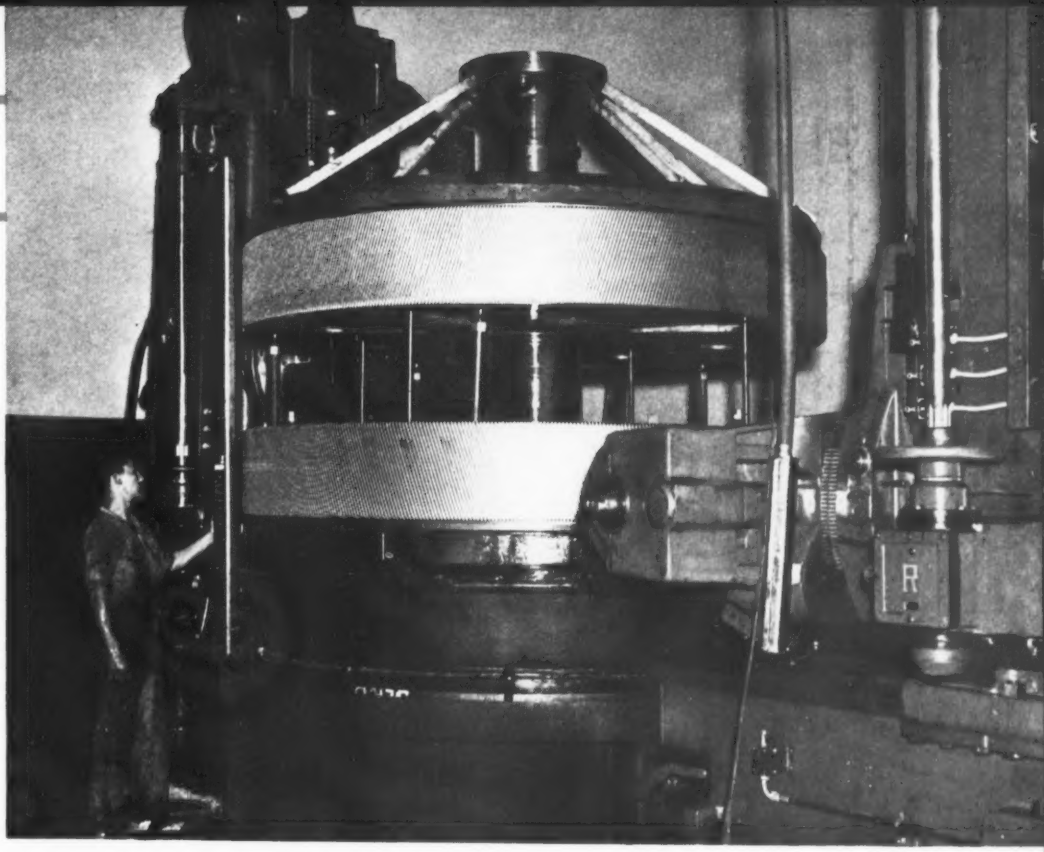


Fig. 3. Turbine Gears are Large, and Must be Cut with Extreme Accuracy. These Two Bull Gears are being Hobbed in an Air-conditioned Room on a Double-cutter Machine. It Takes 306 Hours to Cut the Teeth

All the gear blanks, except those used for pinions, are completely fabricated from steel plate. Each blank consists of a hub, rim, two side plates, and several radial ribs which act as braces on the inside of the side plates and extend from hub to rim. In the operation shown in Fig. 1, the radial ribs are being welded to the hub and rim of a large gear blank for a 9000-H.P. turbine unit. The blank is being supported on a Cullen-Friestedt 14,000-pound welding positioner.

First- and second-reduction gear blanks are rough- and finish-turned on a Fitchburg 200-inch lathe. The turning of a first-reduction gear blank for a 4000-H.P. turbine unit is shown in Fig. 2. The finished diameter of this gear will be within plus or minus 0.001 inch of 75.525 inches. About eighty-six hours is required for turning, facing, grooving, and chamfering.

Twenty-nine gear-hobbing machines are used to cut the gears for these turbine drives, and each is set up to handle a specific size of gear; thus, these machines can be operated almost continuously, requiring a comparatively short idle period for removing a finished gear and placing a gear blank in position on the work-table. The gears cut on these hobbing machines range in size up to 146 inches in diameter. The

Fig. 4. Interesting Work Lay-out Fixture under which Turbine Cylinder Base is Supported on Jacks. "Sounding Pins" and Outline Templets Permit Checking of Casting to Make Sure that there is Sufficient Material for Machining at All Points

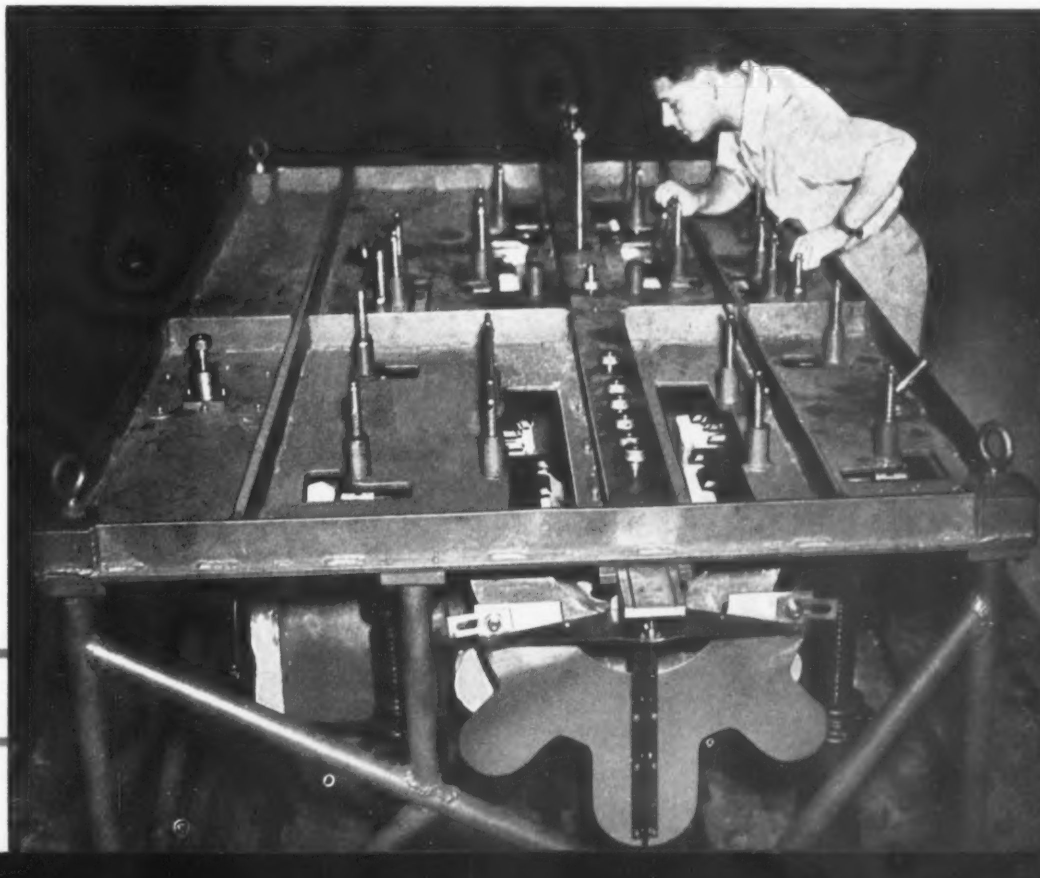


Fig. 5. Bearing Housings, Gear Housings, and Gears are Fabricated from Steel Plate. Beginning of Fabricating Process is Flame-cutting of Parts. Four Duplicate Pieces are Cut out at One Time

accuracy of the tooth thickness must be within plus or minus 0.0005 inch. To insure the maintenance of this accuracy, the gears are cut in air-conditioned rooms having a constant temperature of 70 degrees. Once the hobbing operation is begun on one of these gears, it must be continued without interruption until the teeth are completely finished.

The cutting of two helical bull gears which are to be mounted on the output shaft of a 4000-H.P. turbine unit is shown in Fig. 3. Each of these gears is 104.614 inches in diameter and has 594 teeth. About 306 hours of actual cutting time is required to generate the teeth.

The practice followed in cutting the turbine gears is generally the same as that described in an article published in November, 1938, MACHINERY, page 178, which described operations in the Westinghouse turbine plant that is now engaged in Navy work. The machining of rotors follows the Westinghouse practice outlined in an article published in February, 1939, MACHINERY, page 385.

A rather unusual lay-out fixture developed by Nicholas Shakotko, plant superintendent, is shown in Fig. 4. This fixture, which is about 8 feet long by 4 1/2 feet wide, is used to check and lay out for machining, castings for bases

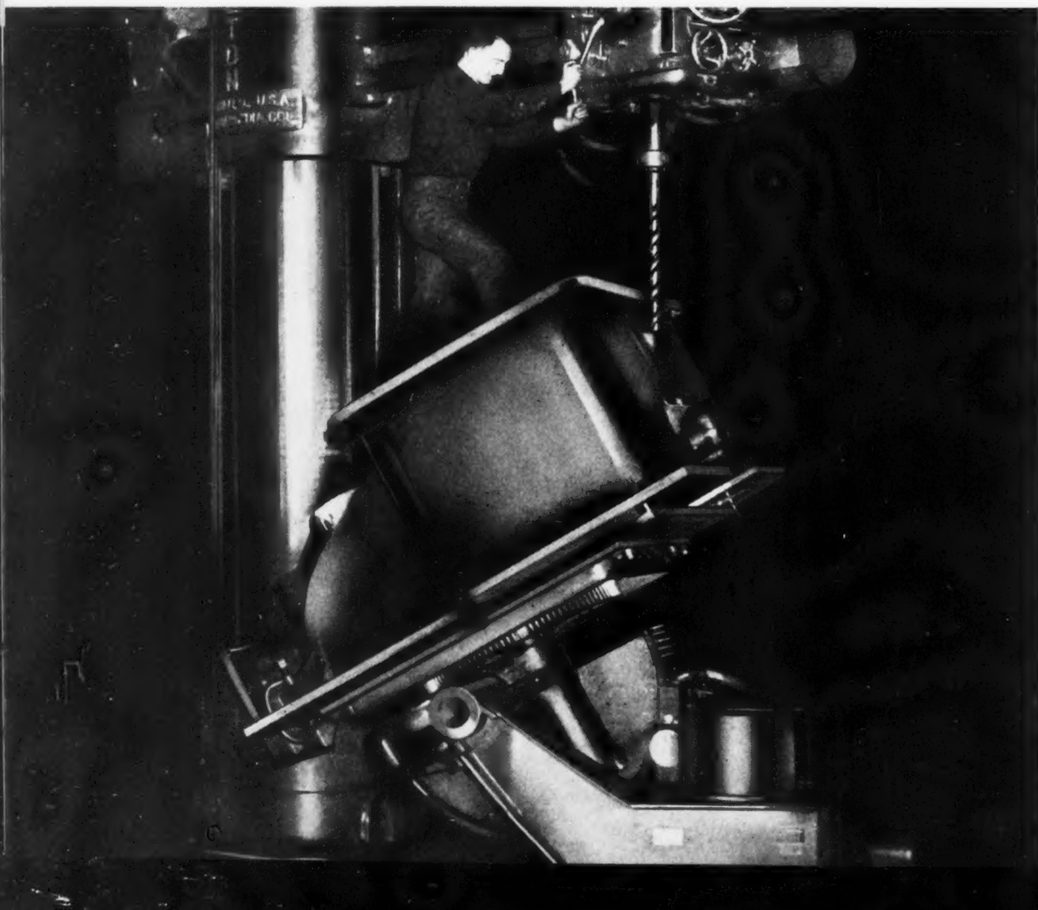


Fig. 6. Welding Positioner Speedily and Accurately Locates High-pressure Turbine Cylinder Base in Any Position Necessary for Drilling Holes at the Various Angles Required

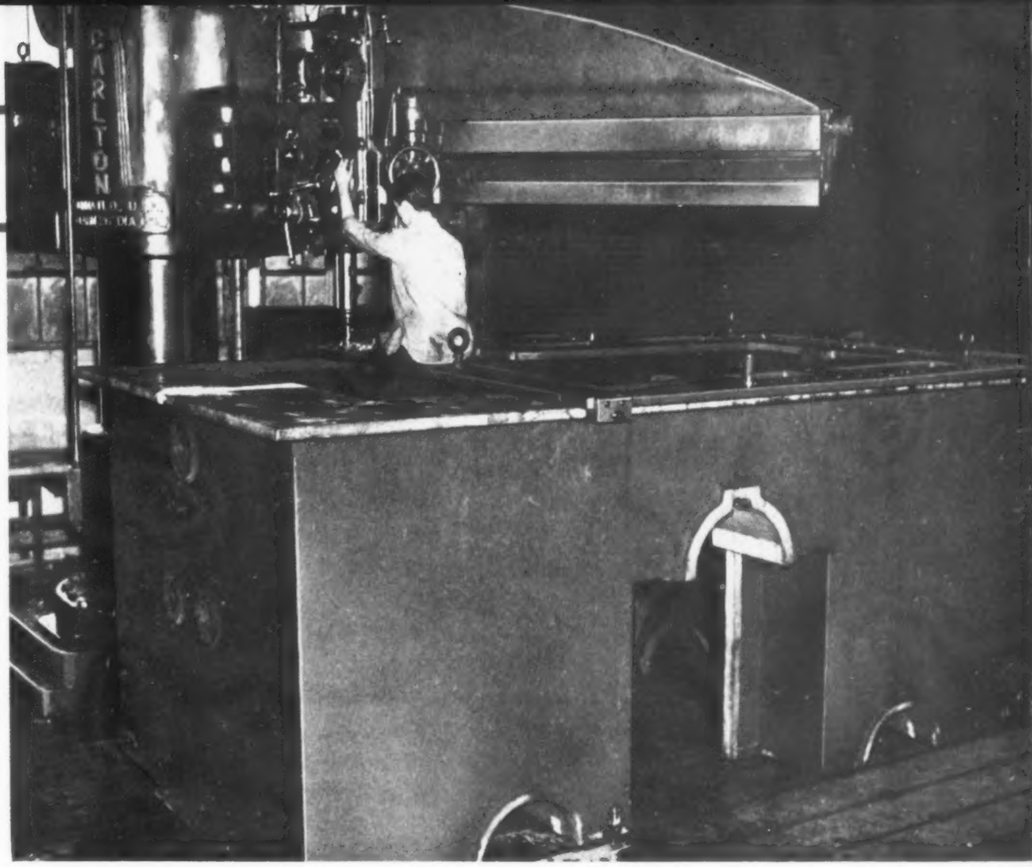


Fig. 7. Two Hundred and Seventy-two Holes Must be Drilled in the Face of This Huge Gear-case. Using a 10-foot Radial Drill, Only Two Shifts in Position of the Work are Required to Complete the Operation

of 8500-H.P. and 9000-H.P. high-pressure turbine cylinders. The casting to be laid out is brought into position beneath the fixture and held at the proper height on jacks. Pins with collars on the top ends, which are shown projecting above the surface of the fixture along the center, are used to take "soundings" at various points along the bottom of the casting cavity. The amount that the shank of a pin projects above the surface of the fixture when the pin is pushed down until its lower end is in contact with the casting indicates the amount of stock that will have to be removed at that point. Should the pin not make contact with the casting when it is dropped down as far as it will go, it indicates that there is not enough stock at that particular point to permit machining to the desired dimension.

At various other locations around the edges of the upper face of the casting where vertical surfaces are to be machined, guide outline templets supported by springs can be pushed down to find out whether there is sufficient stock to permit machining. This is determined by noting if the edge of the intersecting surface lies wholly outside the templet. Vertical templets at each end of the fixture perform a similar function in the laying out of the contour of the

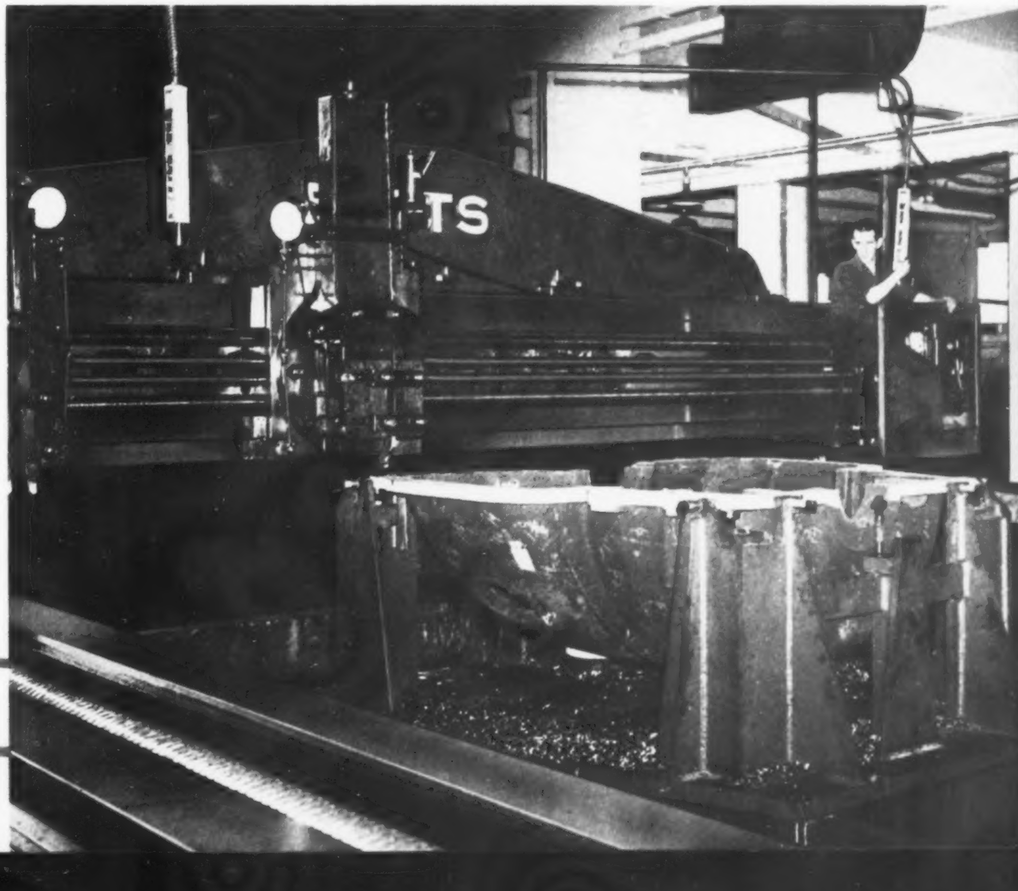


Fig. 8. Planing a Joint Face of a Low-pressure Turbine Cylinder on a Pit Type Planer in which the Tool-head and Supporting Cross-rail are Moved across the Stationary Work

Building

Fig. 9. Milling Right-angle Joint on a Gear-housing Base. This Gear Housing is Built up Entirely of Fabricated Steel Sections

thrust bearing end and the coupling end of the base casting.

In use, the fixture is shifted around in various positions relative to the casting until all the "sounding pins" and guide templets indicate that sufficient stock is available for machining. As a guide to rough-machining, the outlines of the intersecting surfaces are then scribed on the face and ends of the casting with the aid of the guide templets.

To expedite the production of turbine units, welding has been employed more than ever before in this industry. The bearing housings, the gear housings, and, as previously mentioned, even the gears themselves are fabricated from steel plate. Each gear-case is split up into a number of sub-assemblies, such as thrust and coupling end bearings and bearing supports. More men can thus be employed at one time, since each of these units can be fabricated separately and then welded together.

Formerly, the gear housing was built as a single assembly with steel castings used for bearing sections and supports. It is estimated that the new sub-assembly method will save about one-third the time formerly required to fabricate a gear-case as a single unit. The entire gear transmission for a 9000-H.P. marine unit weighs 161,000 pounds, of which approximately 150,000 pounds is fabricated steel plate.

The various parts for these gear housings are cut out of steel plate with Oxweld oxy-acetylene flame-cutting machines, equipped with four torches, as shown in Fig. 5. The torches are guided by the operator through the medium of a templet, four pieces being cut out at one time.

A special welding pit, 60 feet long, 28 feet wide, and 10 feet deep, is provided for final welding operations on large members, such as the gear-case bases. When the work has to be shifted from a horizontal position, this welding pit greatly facilitates the operation by providing a wall against which the heavy casting can be leaned. The need for building some sort of rigid support, which would be the case if the work were done at floor level, is thus removed. Another advantage of this pit is that welding arcs are kept out of the usual line of vision of nearby workmen.

Although the Cullen-Friestedt 14,000-pound positioner shown in Fig. 6 was purchased for welding operations, it was first tried out as a work-holder for castings in which it was necessary to drill a number of holes at widely different angles. The ease with which these castings could be held in the exact position for drilling, no matter what the angle, can be easily visualized from this illustration. The use of the positioner was so successful that it stayed on the drilling job. The drilling in the particular operation shown is being accomplished by using a Carlton radial drilling machine.

Considerable drilling must be done on each face of the gear-case bases. In Fig. 7, a 10-foot

Fig. 10. Grinding the Joint Faces of a High-pressure Cylinder Blade Ring. Special Fixture Facilitates Rapid Loading and Accurate Facing

Carlton radial drilling machine is being used to drill 272 holes in the face of a gear-case base for a 4000-H.P. turbine unit. The base is about 8 feet wide and 12 feet long. It is necessary to move the work only twice to complete the drilling operation.

Large castings and fabricated units are planed on the Betts pit type planer shown in Fig. 8. In this machine, the cross-rail is traversed along the work, which is mounted in a fixed position in the pit. The job shown in the illustration consists of planing the joint face of a 9000-H.P. low-pressure turbine cylinder cover. High-speed steel tools are used, and a 3/4-inch cut is taken with a 1/16-inch feed. The cutting speed is 40 feet per minute.

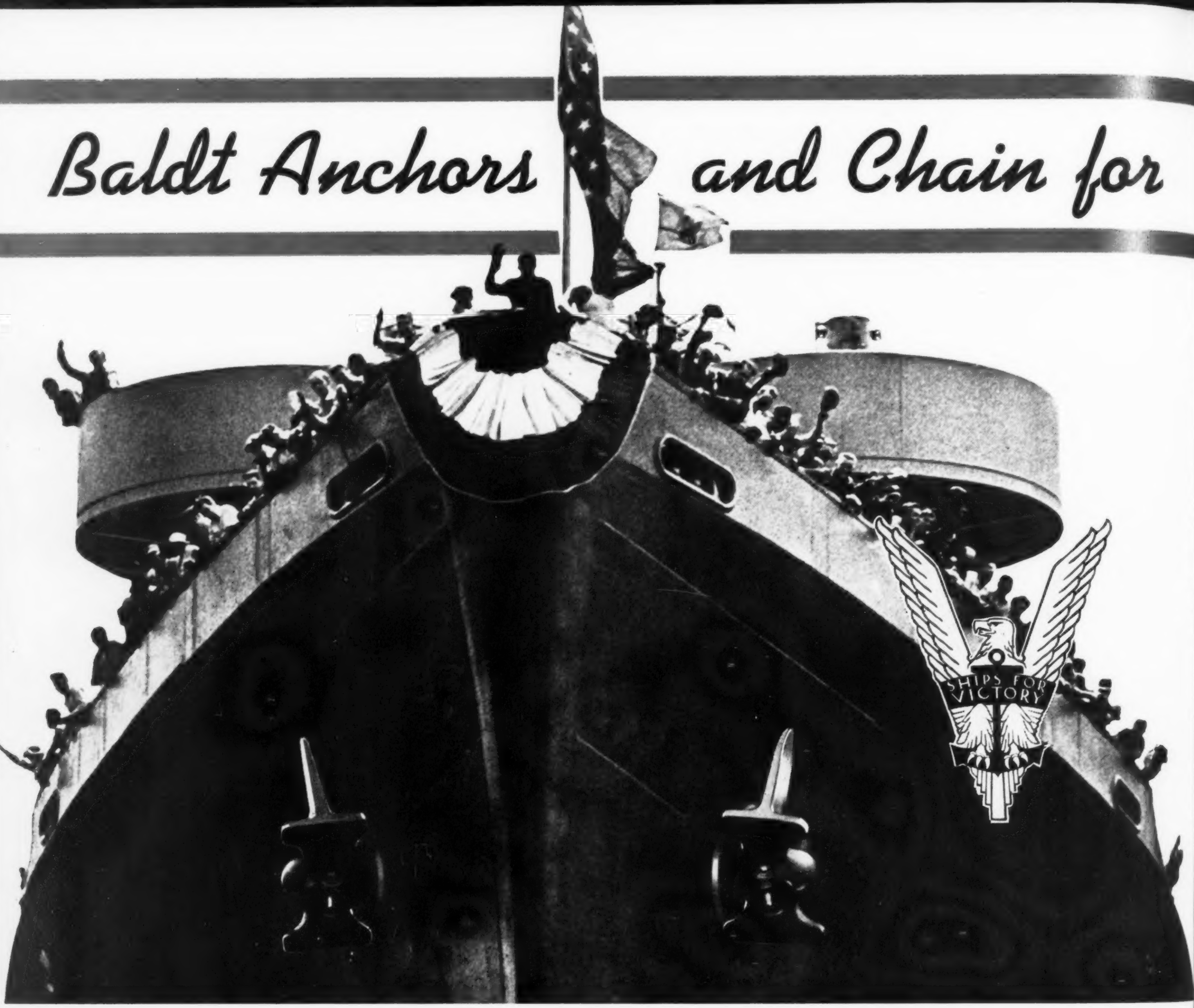
Thrust and coupling bearing joints on gear-housing bases and covers are milled on an 8-inch Ingersoll boring, drilling, and milling machine. One of these operations—the milling of a right-angle joint on a gear-housing base for a 4000-H.P. turbine unit—is shown in Fig. 9.

A good example of the methods used to secure volume production in this plant is shown in Fig. 10. In this operation, the joint faces of a high-pressure cylinder blade ring are being ground on a Hanchett 36-inch face grinder. A work-holding fixture is used to permit rapid loading and unloading and to insure that every part will be ground exactly the same. Just before this operation, the piece is rough-milled and is then given a stress-relief anneal.

This method of machining the joint greatly reduces the amount of filing and scraping needed to obtain a fit that will be steam-tight. Previously, a planing operation was employed, and 0.003 to 0.004 inch of stock was left to be filed and scraped off. By changing to a grinding operation, the allowance for finishing was cut down to 0.001 inch.

Some of the operations on the turbine blades will be described in a second installment of this article, which will be published in a coming number of MACHINERY.

Baldt Anchors and Chain for



Forging Di-Lok Anchor Chain and also the Shanks and Shackles that are Assembled to Cast-Steel Heads to Make up Baldt Anchors

By E. J. McGUINESS, General Manager
The Baldt Anchor, Chain and Forge Co.,
Chester, Pa.

Approved for Publication by the Navy Department

ANCHORS have been used since times beyond the memory of man for mooring ships in a given locality, secure from drifting winds, tides, or currents. They are frequently the only means available of preventing a ship from being driven on dangerous reefs or rocky shores when heavy seas are raging. Aptly, they have been called a ship's "brakes." The anchors used by the ancient Greeks were huge stones, baskets of smaller stones, sacks filled with sand, or wooden logs loaded with lead. Such devices merely held a vessel by their weight and by friction as they were dragged along an ocean's bottom. They were far removed

Ships to Sail the Seven Seas

from the heavy anchors of today, which must actually sink into the ocean floor to securely hold vessels of thousands of tons displacement.

Since the beginning of this century, the Baldt Anchor, Chain and Forge Co., Chester, Pa., has been engaged in the manufacture of ships' anchors. At first, the old style "pick anchor" was produced, but about 1904 the Baldt company developed the stockless anchor which has since come into universal use. This anchor is of such design that its chain and shank can be drawn into a hawse-pipe in the hull of the vessel, so that the anchor need not be hoisted on deck, as was the case with the anchors of bygone days. Stockless anchors are always ready to be dropped into the sea immediately in case of emergency.

In 1918, the Baldt company started also to manufacture anchor chain, when it developed the Di-Lok stud-link chain, which is forged entirely in dies from alloy steel. This chain is standard for all vessels of the United States Navy, and has also been approved by the American Bureau of Shipping and Lloyd's Register of Shipping. It is being supplied in large quantities for cargo vessels and oil tankers being built under the program of the Maritime Commission. Anchors, complete with shanks and shackles, are also being furnished for the Commission's vessels.

Di-Lok chain has been used to a large extent by the Tennessee Valley Authority for operating dam control gates. The most spectacular application, however, was in dragging a plow across ocean bottoms to dig a trough at depths as great as 2000 feet for laying transatlantic cables. A chain 4200 feet long was forged of 12,500 individual links for this unique application. It weighed 43,000 pounds. The plow itself weighed ten and one-half tons in air and nine tons in water.

An impression of the heavy anchor production in the Baldt shop may be gained from Fig. 1, which shows a general view of the assembly floor. Here the long forged shank is inserted through the anchor head from the bottom side,

Fig. 1. Anchors for the Fleet of Cargo Vessels being Built by the United States Maritime Commission, in the Process of being Assembled

Baldt Anchors and

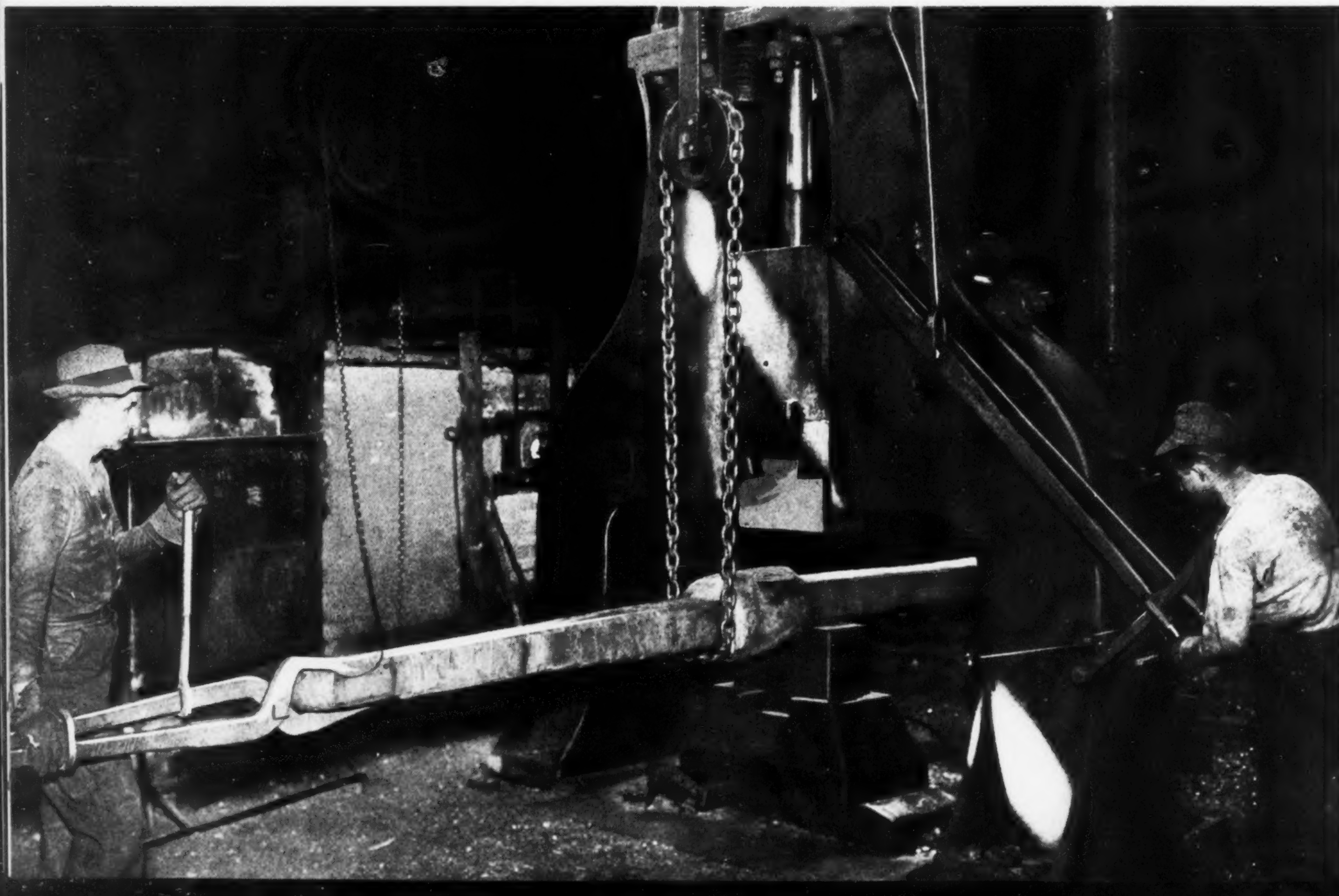
and then a pin about 4 inches in diameter is driven hot through two lugs cast on the bottom of the anchor and across the ball end of the shank. This pin prevents the anchor head from rising along the shank after installation aboard ship, and yet allows a free swiveling action between the anchor head and the shank.

The shackle is then assembled to the top end of the shank by driving a second pin hot through the two shackle eyes and a hole forged in the shank. In driving both pins, a heavy bar suspended from a crane is held against one end of the pin, as shown in the illustration, while men direct blows on the opposite end with sledge hammers. The use of the heavy bar results in a nicely rounded head on the pin at one end, and the other end is peened over with the sledge hammers to a smoothly rounded contour. The cast-steel anchor heads are not actually cast in this shop, but are produced from Baldt patterns.

Important tests are made on the anchors both before and after assembly to make certain that they are capable of withstanding severe usage. For example, each anchor head is raised to a height of 12 feet in the inspection illustrated in Fig. 2, and allowed to drop on heavy steel billets that lie on the shop floor. The anchor is made to drop in such a way that ears on the opposite sides strike the billets. Incidentally, one of

Fig. 2. Every Anchor Head is Given a Drop Test from a Height of 12 Feet, in which the Opposite Ends on the Bottom Side Strike Heavy Billets on the Floor

Fig. 3. Forging Two Anchor Shanks from One Billet under a 3000-pound Steam Hammer



Chains

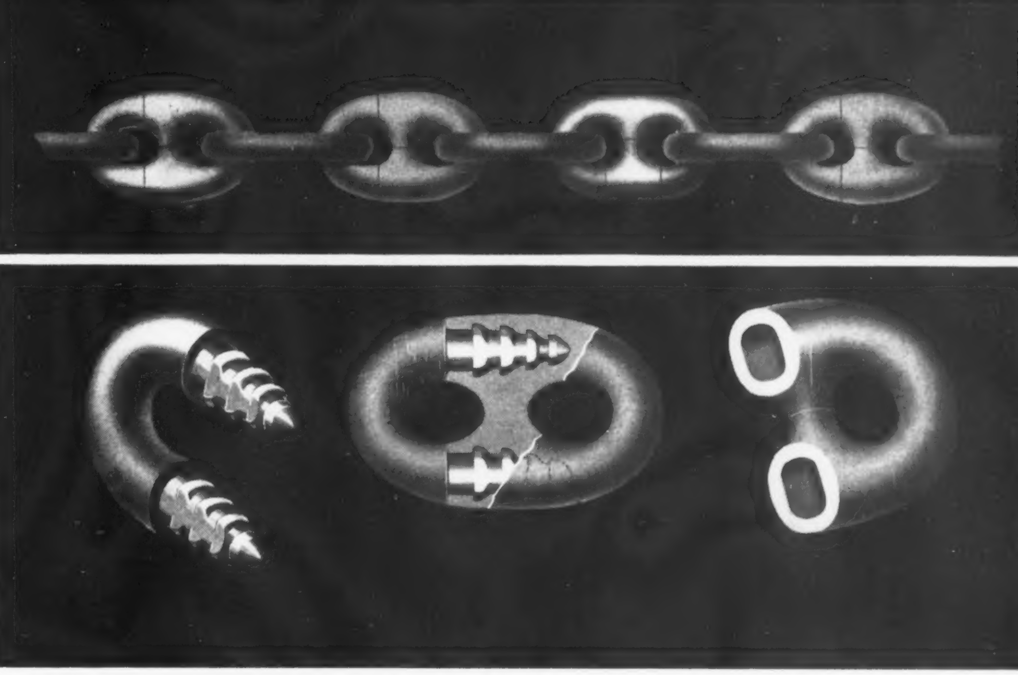


Fig. 4. (Top) Section of Di-Lok Anchor Chain; (Bottom) Individual Male and Female Link Members and Assembled Link

these anchor heads for a Liberty ship weighs about 8440 pounds. Anchors for ships of this type are seen lying in the foreground in Fig. 1.

After assembly, stringent tests are made on the anchor shank and shackle, by means of a physical property testing machine, to make certain that these important parts meet specifications as to tensile strength and other physical characteristics.

Important forging operations in the manufacture of shanks, shackles, and chain will be described in the following. Fig. 3 shows the manner in which two shanks are forged from one billet. The machine used is a Chambersburg 3000-pound hammer. The billet was first heated to about 2200 degrees F. in the oil-fired furnace seen in the background, and transferred to the hammer by an overhead crane, from which it is also suspended during the forging operation.

The shanks being forged are intended for use with 5000-pound anchor heads, and are therefore lighter than the shanks required for the anchors of Liberty ships. The billet in Fig. 3 was 12 inches square by 64 inches long when it came from the furnace, and was drawn out under the forging hammer to an over-all length of 163 inches. When the billet is cut through in the center, each of the resulting shanks will weigh approximately 1470 pounds.

After shackles have been forged into straight bars with eyes on the ends on forging hammers equipped with suitable dies, they are brought to the bending slab shown in Fig. 5 to be bent into a U-shape. One end of the shackle is clamped to a cylindrical form, and the other end is fastened to a cable which is passed over a sheave about 12 feet distant and then connected to the drum of a motor-driven winch seen in

Fig. 5. Employing a Motor-driven Winch to Bend a Straight Forging into an Anchor Shackle of U-shape

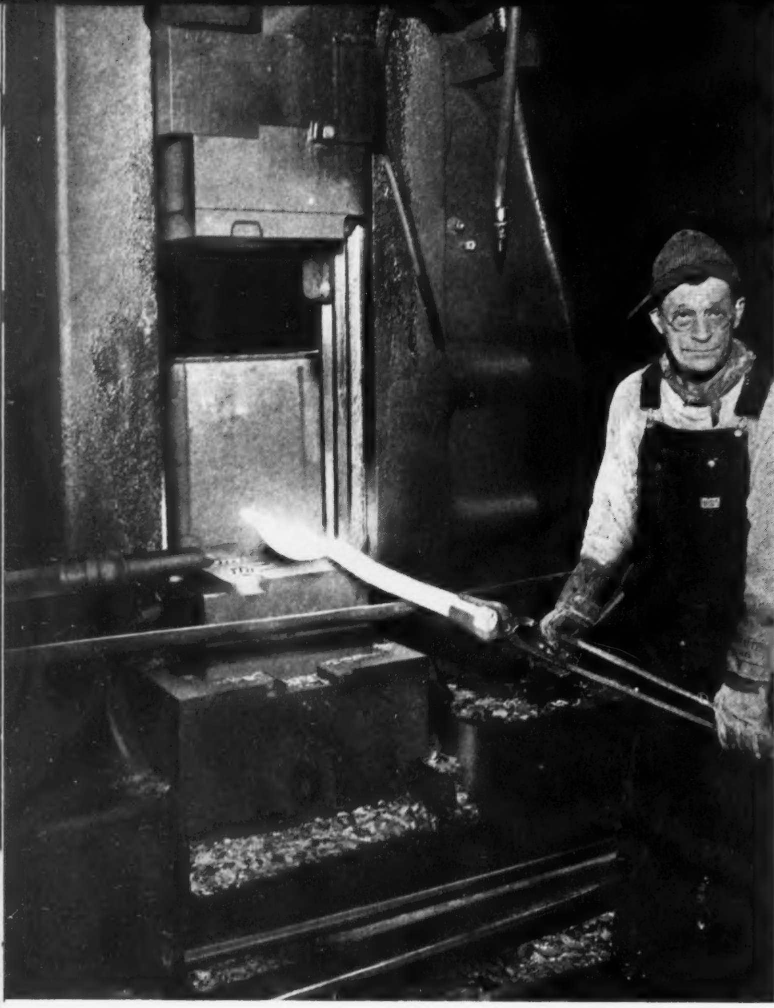


Fig. 6. Male Link Members are Forged Two from One Bar in an Operation Such as the One Here Illustrated

back of the bending slab. When the winch is operated the shackle is quickly bent around the form. At a point about midway in the operation —when the shackle has been bent through about 90 degrees—the cable is slipped off the sheave and passed over another sheave located in back of the bending slab, in order to obtain a pulling action in another direction, as required to complete the 180-degree bend.

Before describing forging operations involved in making Di-Lok link anchor chain, it would be well to outline the design of the links. Each link is made up of a drop-forged male member, such as seen at the left in the bottom view of Fig. 4, and a female member, such as seen at the right, which is produced in a forging machine. In assembling the two link halves together the projecting ends of the male member are inserted in the sockets of the female member, and then the wall that surrounds the sockets is tightly squeezed around the male projections by the blows of a steam hammer. After assembly, the annular rings on the projections of the male member effectively prevent the pulling apart of a link. These Di-Lok link members are forged from a 3 1/2 per cent nickel steel which contains 0.40 per cent carbon. All furnaces used in producing these parts are automatically controlled.

Male link members are forged two from one bar. Fig. 6 shows a typical operation being performed on a Chambersburg steam hammer of 2500 pounds rating. Stock 2 5/16 inches in diameter, in bars several feet long, are heated in an adjoining furnace to suitable forging temperature, and then handed to the operator of this machine, who first blanks the heated stock

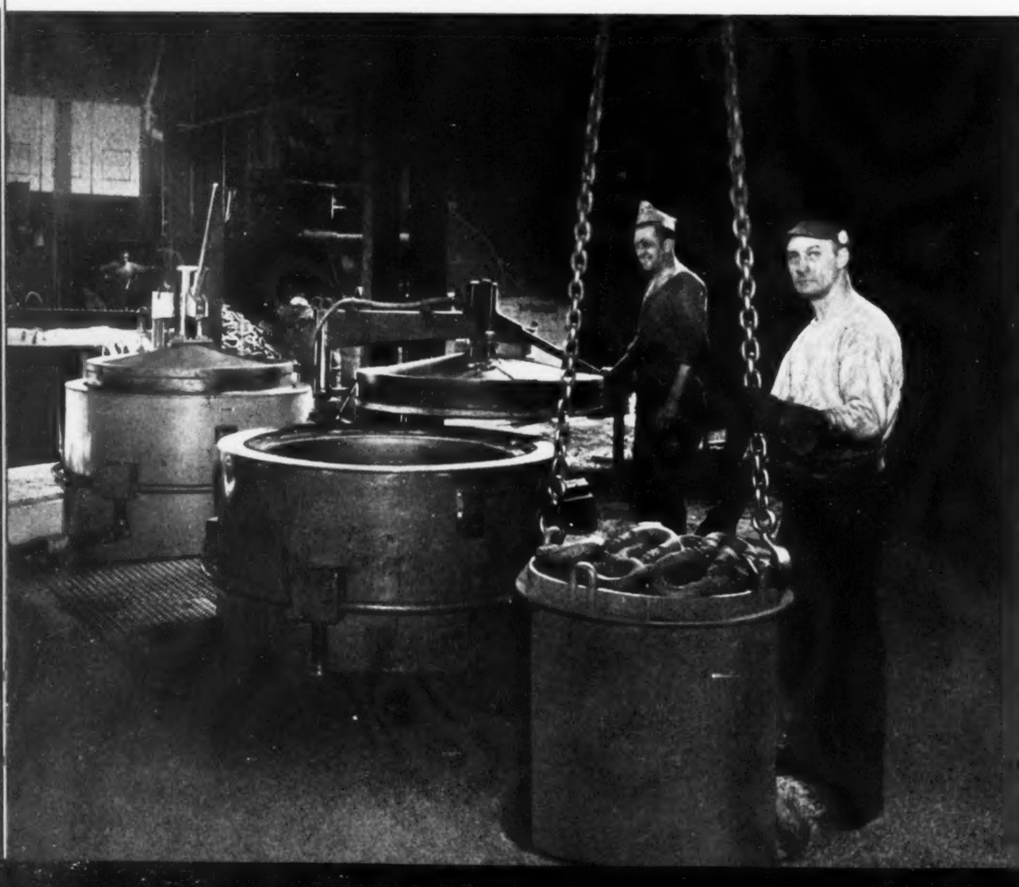


Fig. 7. Hump Electric Furnaces in which the Male Link Members are Tempered after being Quenched in Water in a Hardening Furnace

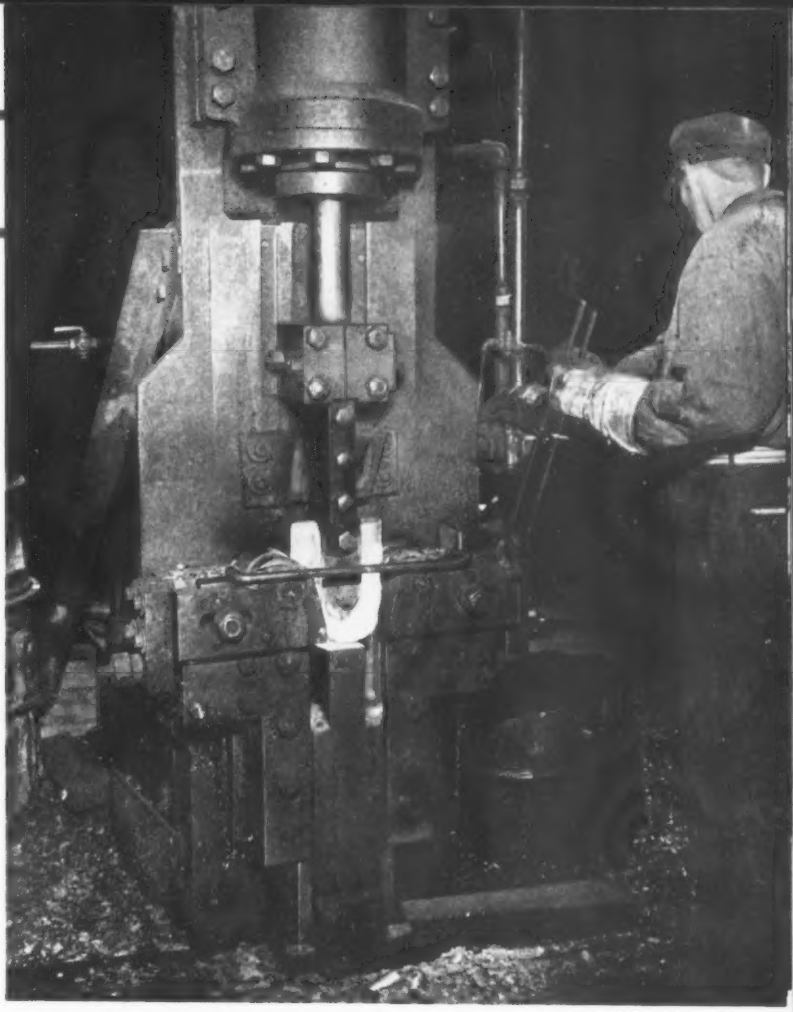


Fig. 8. The First Step in Forging the Female Link Member Consists of Bending a Heated Bar to a U-shape

in an impression on the left-hand side of the die. This puts a slight bend in the stock at approximately the middle.

The heated stock is then shifted to an impression on the right-hand side of the die, and is bent to a U-shape under several blows of the hammer. The stock is next turned over 90 degrees so that the U-shaped portion can be laid flat in the impression in the center of the die. Here the male projections are drawn out to a taper and the annular rings are formed. Four or five blows are struck in this impression.

The forged piece is next sheared off by a separate machine, and then trimmed in dies mounted in a mechanical press. The stock that remains after the forging operation is returned to the furnace for reheating prior to forging a second male link member.

Maximum strength of these male link members is developed by hardening and tempering operations. They are hardened by passing through a continuous pusher type oil-fired furnace, which heats them to 1575 degrees F. and automatically quenches the links in water without exposing them to the shop atmosphere. The links remain in this furnace approximately ninety minutes. The hardened links are then transferred to the Leeds & Northrup Hump furnaces shown in Fig. 7, where they are held for two and one-half hours at a temperature of 900 degrees F. in order to obtain the desired temper. Approximately 225 links, which weigh 1 1/2 tons, are loaded into a basket at one time.

The first step in forging the female link member consists in bending it to a U-shape under the special hydraulically operated machine illus-

Fig. 9. Type of Forging Machine Used in Producing the Sockets and Stud in the Female Section of Di-Lok Anchor Chain Links

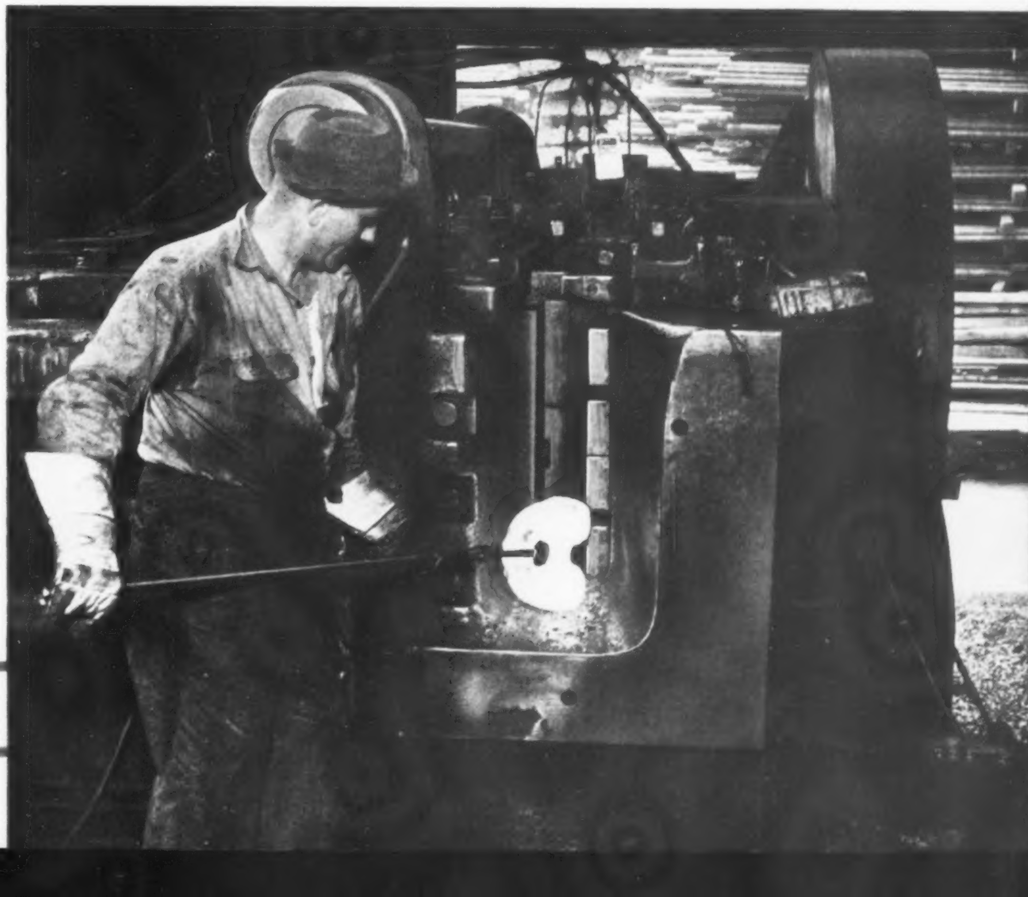
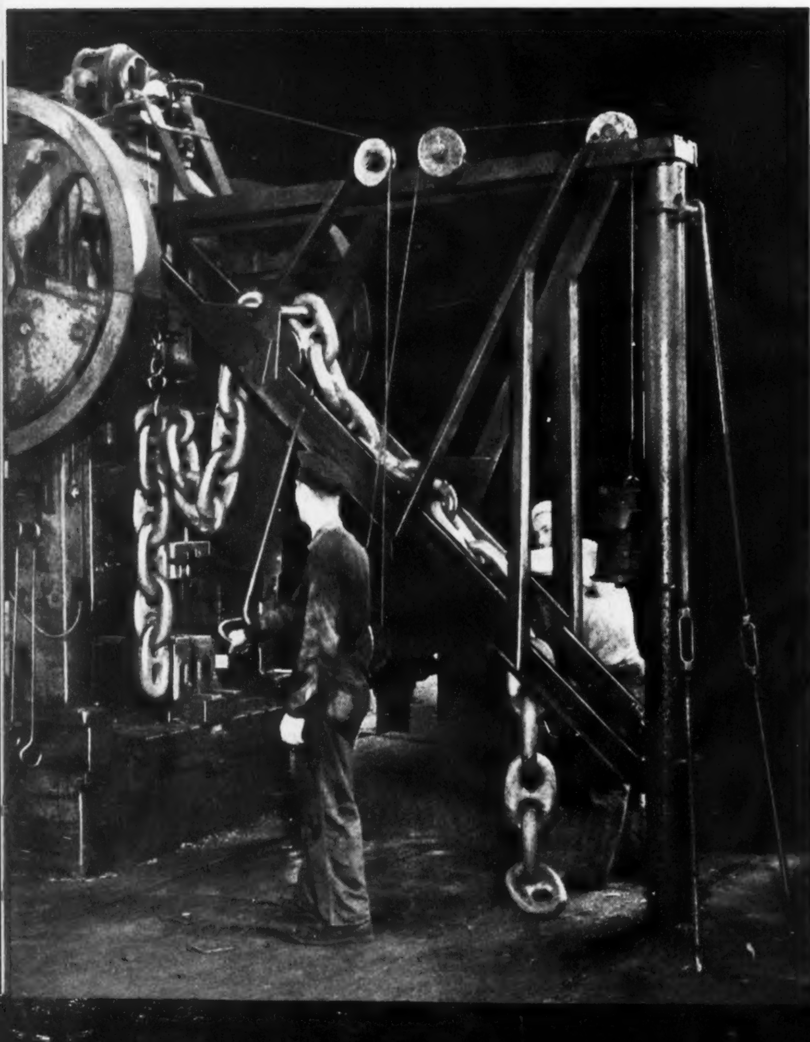


Fig. 10. Assembling Members of the Di-Lok Anchor Chain on a Heavy Steam Hammer

Fig. 11. A Jib Crane Transfers Chain from Assembling Hammer to Trimming Press



trated in Fig. 8 after the stock, previously sheared to length, has been heated to forging temperature in an oil-fired furnace located to the left of the machine. In the bending operation, the heated stock is laid across two rollers and an anvil at the top of a vertical slide. When the ram descends, a suitably shaped punch attached to the bottom of the ram pushes the heated bar downward between the rollers and against pressure exerted by the bottom slide until the stock is bent to a U-shape around the punch. The illustration shows a forging that has just been completed. The ram and the bottom slide are ready to return to their upper positions, so as to allow the part to be taken from the machine. The bottom slide acts against the pressure of a heavy coil spring.

The U-shaped piece is next placed in a furnace at the right of the machine for again heating it to forging temperature, after which it is passed to the operator of the adjoining 4-inch Ajax forging machine shown in Fig. 9. Here it is forged and extruded to shape ready for assembly to a male member. The dies of the forging machine are made with two impressions. The heated U-shaped piece is first placed in the top impression with the two ends pointing into the machine.

When the machine is operated, two die halves come together sidewise to close on the heated stock, and then the ram of the machine advances to bring two punches forward for piercing openings in the ends of the forging. The integral studs which strengthen the finished link in the center are also started in this step of the operation by extruding metal from the original stock.

The part is now transferred to the bottom die impression, which completes the external shaping of the link member, while punches again advance to complete the formation of the sockets in the ends of the part.

When these link members are taken from the forging machine, they are placed in another furnace to be reheated again, and are then ready to be assembled on male links in an operation performed as shown in Fig. 10. The particular machine illustrated is a Morgan 8000-pound steam drop-hammer. The hammer operator seen at the front side of the machine slips an unheated male link member through the preceding link that has been assembled, and then holds

and Chains

this male link member with the projections tilted slightly upward on the back portion of the die face. His helper on the rear side of the hammer then takes a heated female member from the furnace with a pair of tongs and pushes its sockets solidly over the projections of the male member. With the female member still at forging heat, the hammer is then operated to compress the socket walls of the female part solidly on the projections of the male part, so that the two members are securely assembled. Complete assembly is generally effected by two hammer blows. The die-blocks are cut out on the front side to accommodate the preceding link to the one being forged which is necessarily held in a vertical plane.

The heavy chain being assembled is supported by a jib crane which is located midway between the forging hammer and a Bliss mechanical press used to trim the assembled links immediately after they have been put together under the hammer. A general view of this crane is presented in Fig. 11. The assembled links are pulled up over a sheave and permitted to slide down the frame structure to the floor.

From the close-up view of the trimming operation shown in Fig. 12, it will be seen that the dies used in this operation are also cut away to accommodate the link previously trimmed. When the punch descends, the section of the die on which the link is placed is pushed down into the die-block. Trimming is accomplished as the link slides downward past the outer stationary section of the die-block and two inner stationary post-like sections.

All chain produced in the plant is subjected to stringent tests to make certain that it meets specifications for physical characteristics. The chain produced in the operations illustrated was all made from 2 5/16-inch bar stock.

A machine shop of medium size is maintained for finishing operations on shanks and shackles and for producing and maintaining the many drop-forge dies required. In Fig. 13 is shown a Kellermatic automatic tool-room machine engaged in reproducing a die-block such as is used in the bottom position of Ajax forging machines for forging female link members. Correct contours of the die impression are obtained by the use of a master templet mounted on the machine above the work.

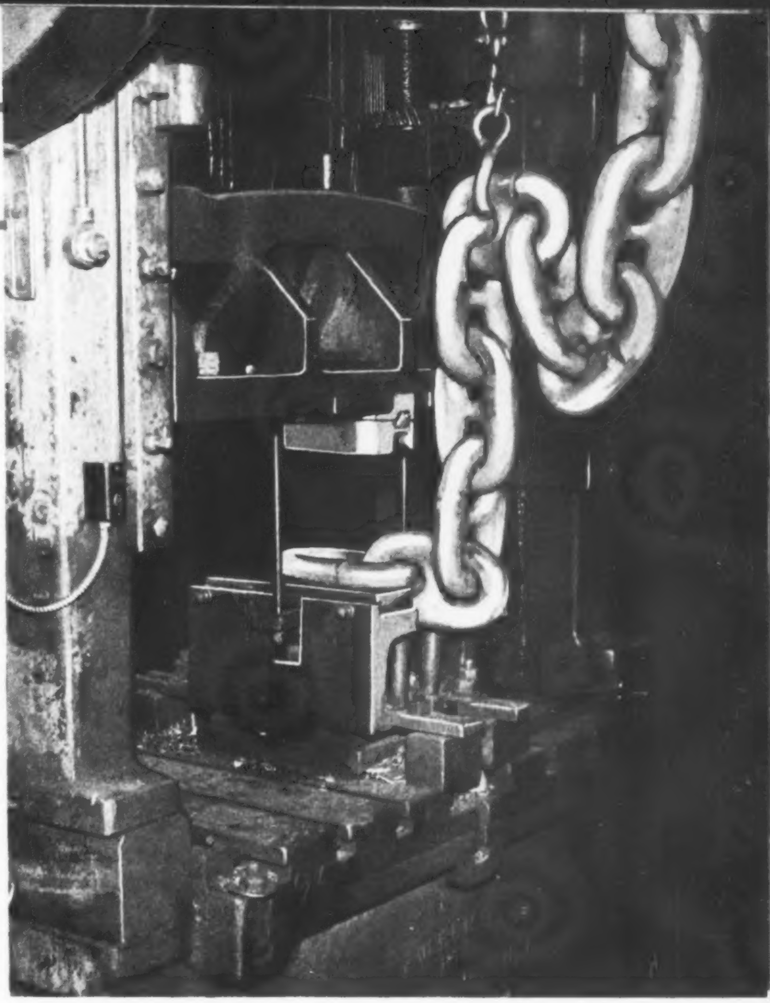
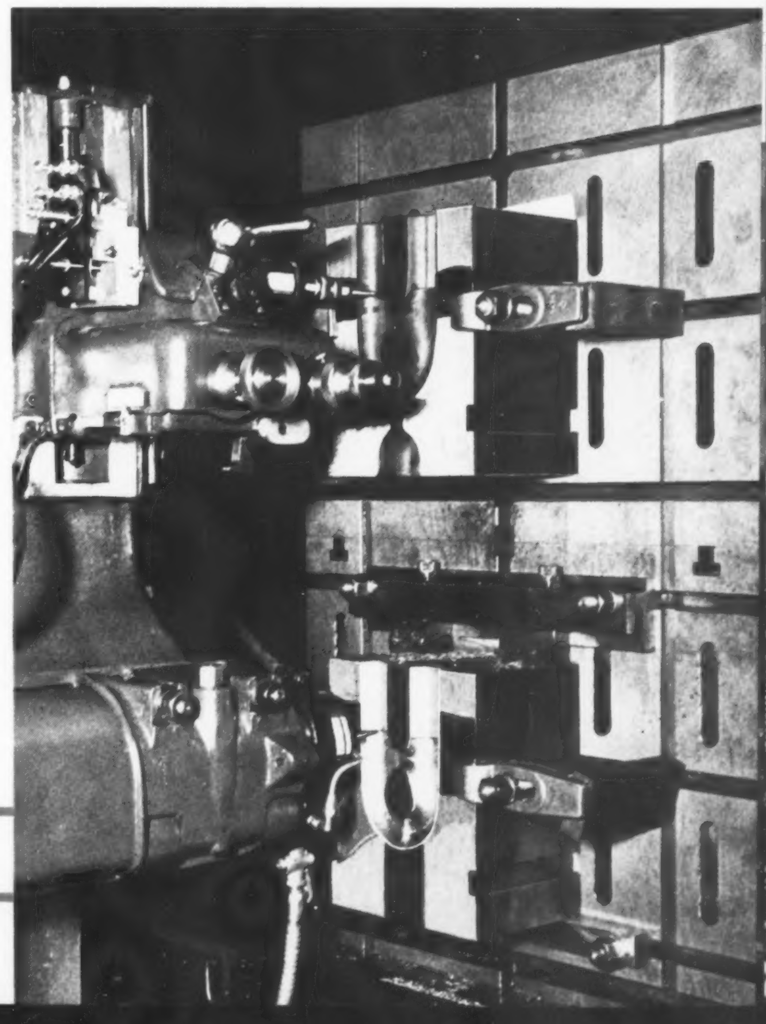


Fig. 12. Trimming an Assembled Link of Di-Lok Anchor Chain after Forging

Fig. 13. Machining Die-block for Link Member on a Kellermatic Tool-room Machine



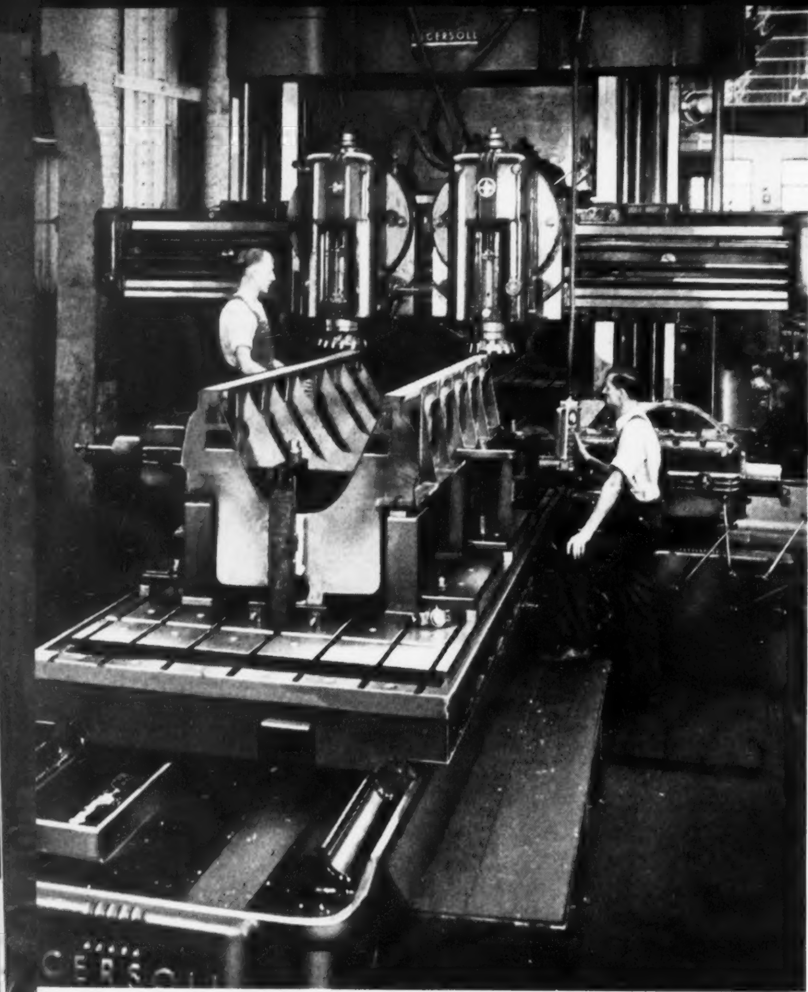


Fig. 1. Face-milling along Two Sides of a Marine Diesel-engine Frame

Fig. 2. Drive End of Six-cylinder Marine Diesel Engine, Showing Electric Coupling in Foreground

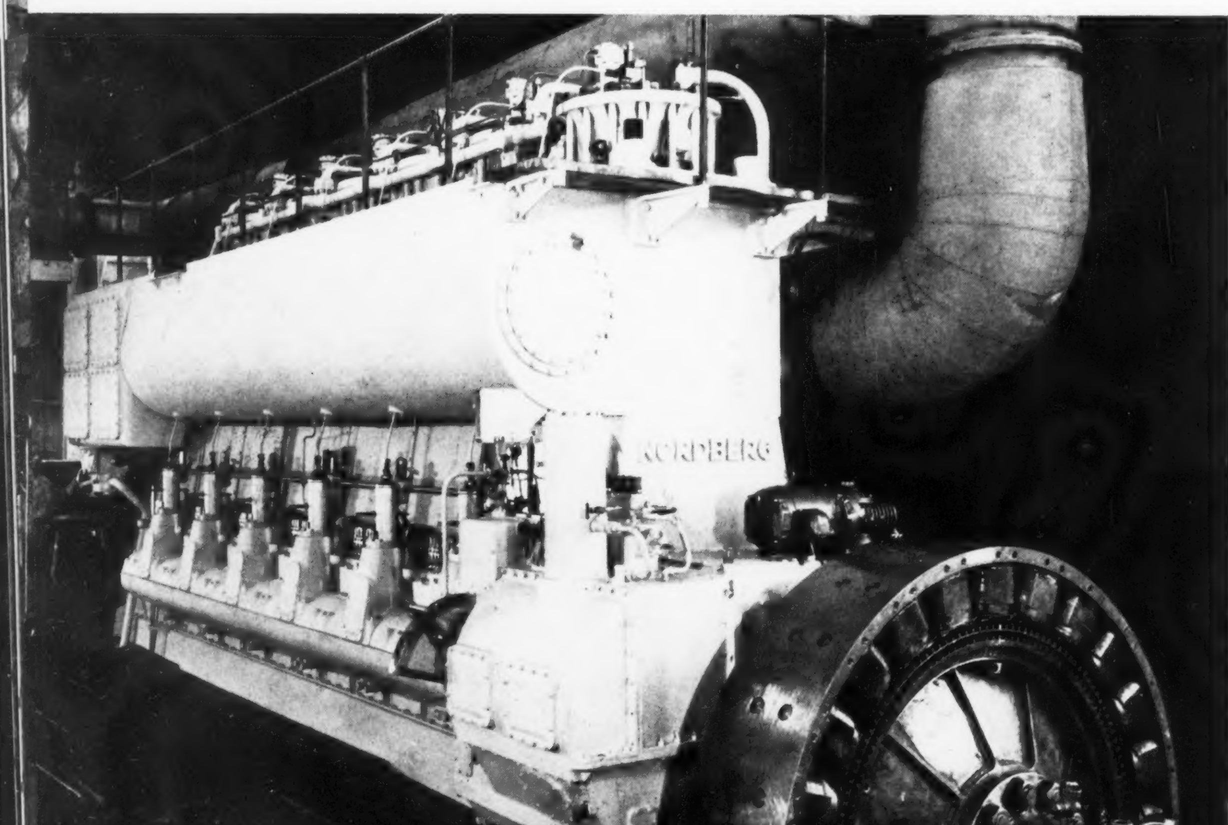
Diesel Engines of the

Approved for Publication by

Along with Other Forms of Propulsion Equipment, Diesel Engines are Playing Their Part in Driving Our Merchant Fleet over Far-Flung Ship Lanes Leading to the Allied

TO provide motive power for the hundreds of ships that will make up our projected merchant fleet, every feasible form of propulsion equipment—steam turbine, steam engine, and Diesel engine—must be utilized to the fullest extent. At the plant of the Nordberg Manufacturing Co. in the Middle West, Diesel engines similar to the one shown in Fig. 2 are being built in large numbers for installation in merchant ships under construction in the South.

These engines will be of the six-cylinder, two-cycle, mechanical injection type, with a 21 1/2-inch bore, a 29-inch stroke, and a rotational speed of 220 R.P.M. The illustration shows the



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...by the U. S. Maritime Commission

Armed Forces. Some of These Vessels are being Equipped with Marine Diesel Engines Built by the Nordberg Manufacturing Co. by Methods Such as Shown Here

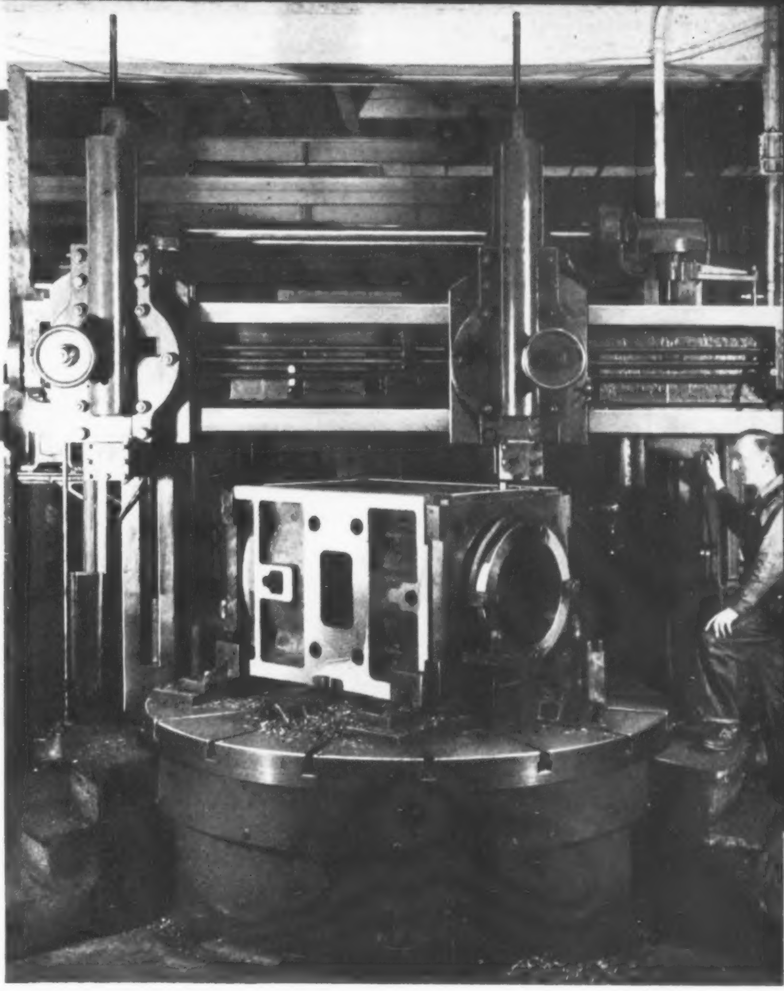


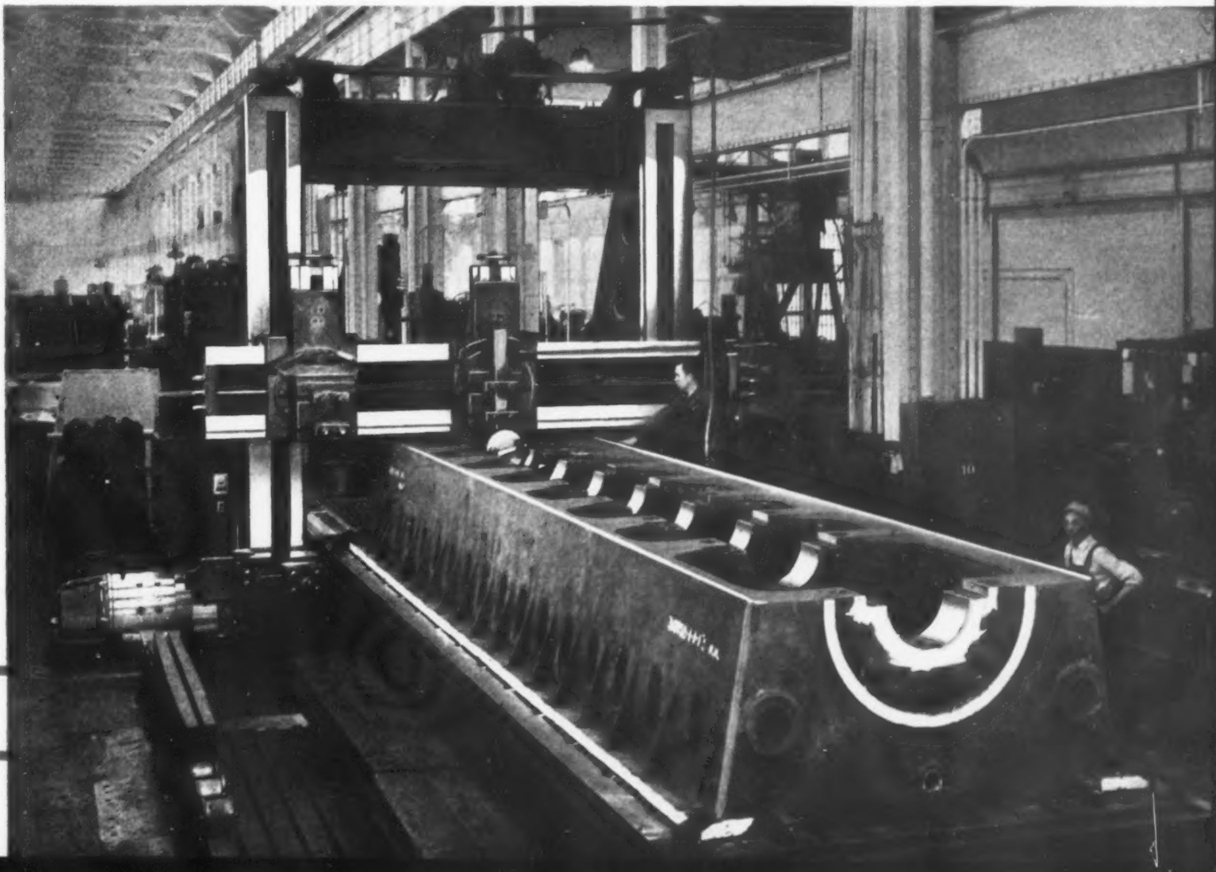
Fig. 3. Facing a Cylinder Block on a 100-inch Boring Mill

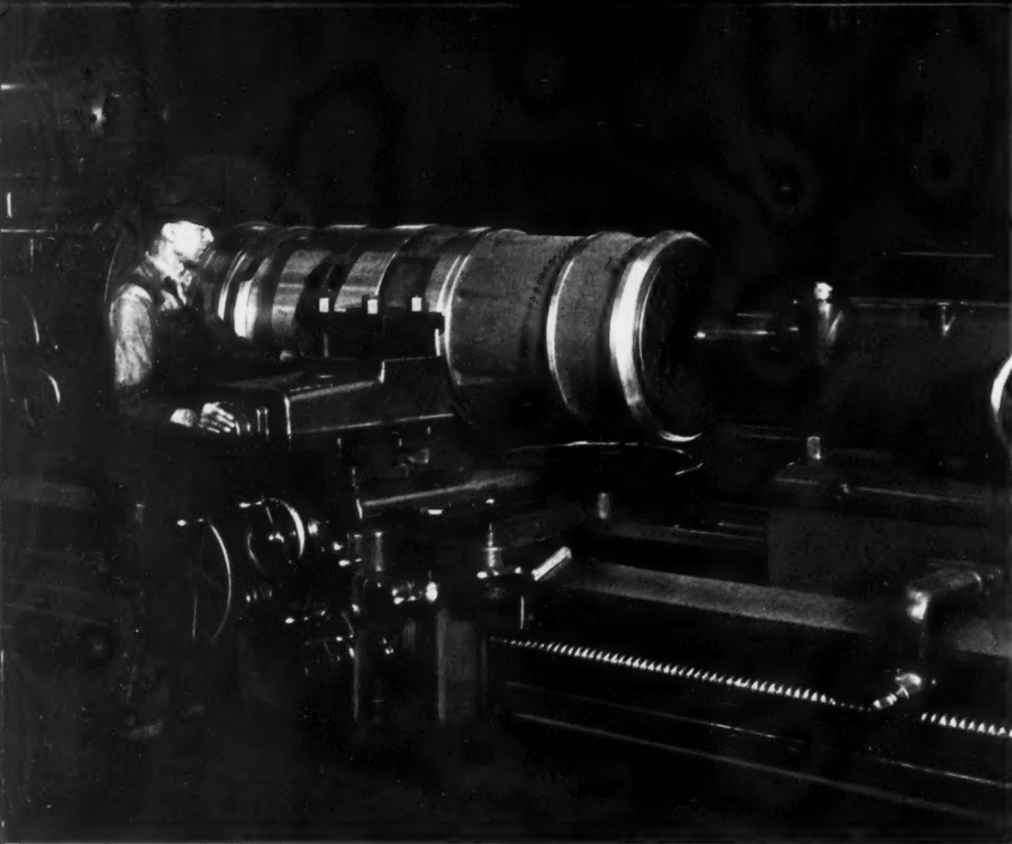
drive end of one of these engines. The large circular unit in the foreground, which somewhat resembles a generator, is an electric coupling which connects the Diesel engine with the propeller shaft. Two of these engines will be installed in each merchant ship.

In Fig. 1 an Ingersoll milling machine is seen face-milling two sides of a frame for a high-speed Diesel engine.

One of the cylinder blocks used in these engines is shown in Fig. 3 mounted on a 100-inch boring mill, which is facing one side of the block. It is supported by a fixture that is so designed as to facilitate accurate location of the

Fig. 4. Machine Used for Planing the Circular Bearing Surfaces of a Diesel-engine Bedplate





Diesel-Engine

Fig. 5. (Left) Cylinder Liner being Turned on 48-inch Lathe

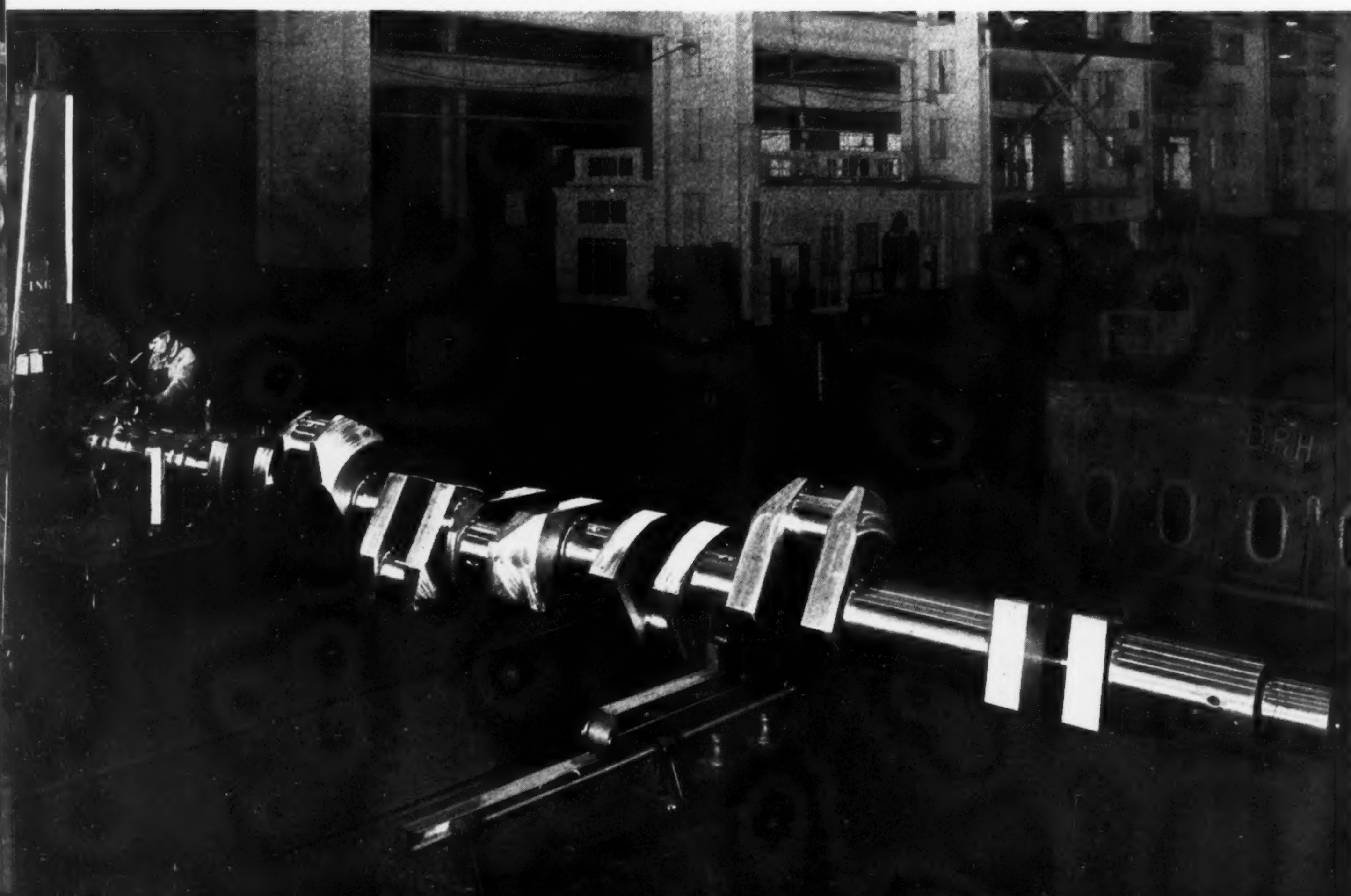
Fig. 6. (Below) Drilling Flange End of Crankshaft for Attaching the Electric Coupling

work for successive facing operations on each of the four sides. This facing operation requires a high degree of accuracy.

The huge bedplate for one of these engines is shown in Fig. 4. Here the circular bearing surfaces in which the bearing shells for the shaft will be placed are being planed. It will be noted that the cutting tool is held in a special head, which is given a rotary feeding movement after each cutting stroke along the length of the long bedplate past the indexing tool-head.

In Fig. 5 a 48-inch LeBlond lathe is seen turning a cylinder liner.

A six-throw crankshaft for one of these engines is shown in Fig. 6 set up for drilling the flange end where the electric coupling will be attached. The flange end of the shaft is mounted on a heavy, flat truck which moves along two



Building

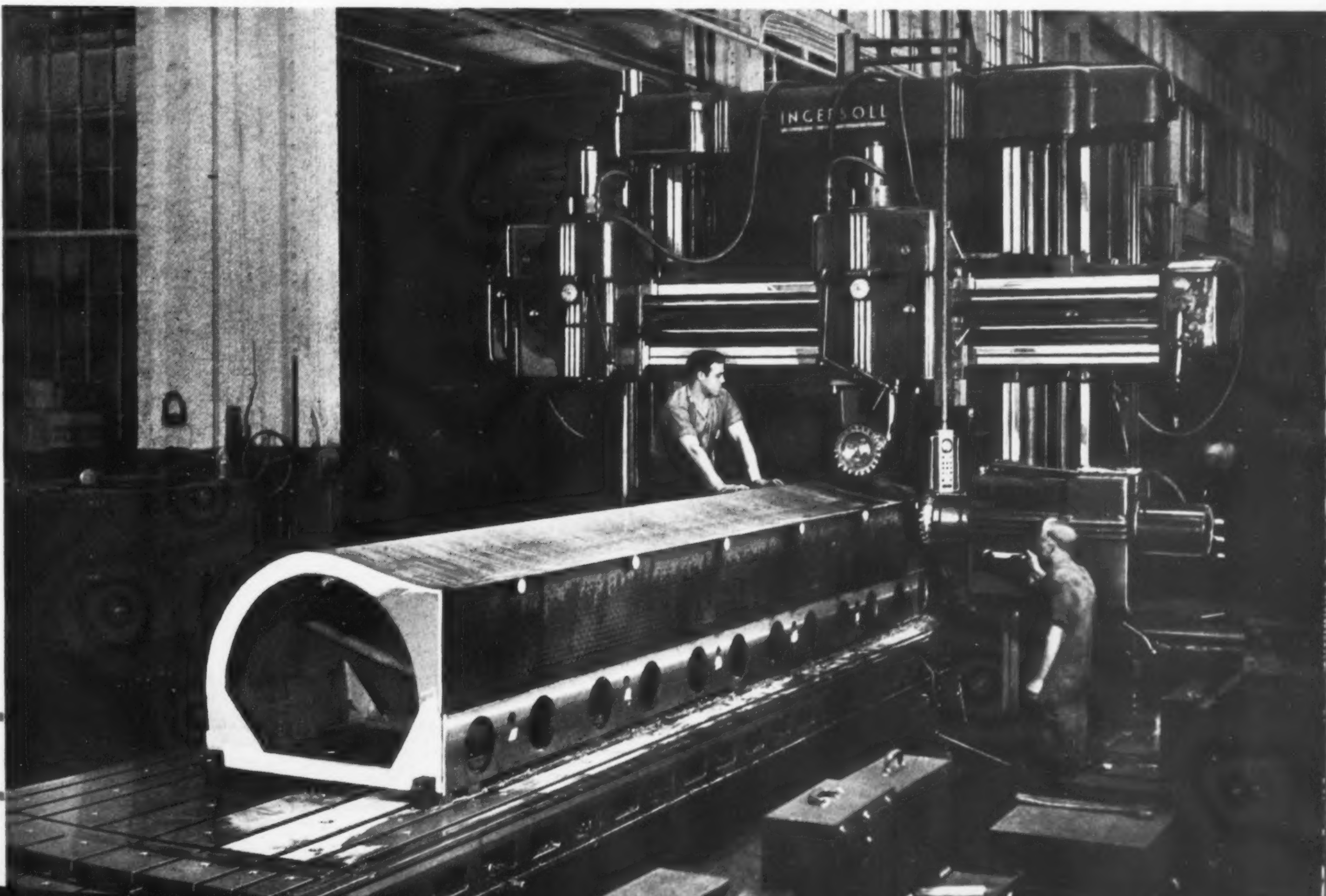
Fig. 7. (Right) Boring Trunk Piston Type Liners on Special Machine

Fig. 8. (Below) Milling Welded Steel Scavenging Air Header on Machine with 65-foot Bed

rails in the conventional fashion, while an outboard support for the shaft is afforded by a roller device, which moves along a single rail supported above the floor in an inverted position. Thus, by horizontal movement of the shaft and vertical movement of the drill head, the flange can be readily positioned for drilling each of the radially located holes.

In Fig. 7 are shown liners of the trunk piston type, which are designed for use with pistons 21 1/2 inches in diameter by 29 inches in length. These liners are being bored on specially built machines, each of which will accommodate two liners at one time.

Fig. 8 shows a welded steel scavenging air header being milled on a four-head Ingersoll milling machine equipped with a 30-foot long table and a bed 65 feet in length.



Liberty Ships Built in Sunken

Methods Employed by the South Portland Shipbuilding Corporation and the Todd-Bath Iron Shipbuilding Corporation in Building Liberty Ships for the United States Maritime Commission

Approved for Publication by the U. S. Maritime Commission

SINCE man began to construct ships, he has generally built them so that they would slide into the water either endwise or sidewise from ways constructed on the ground. Therefore, it was a decided departure from conventional practice when, in 1939, the Todd-Bath shipyard at Portland, Maine, was planned on the basis of building vessels in sunken basins or graving docks. By the use of sunken basins, ships could be constructed in a horizontal position on an even keel, eliminating the necessity for constantly making corrections by the use of

Basins and on Ways

By CHARLES O. HERB

declivity boards, as required when ships are erected on ways, due to the angular position of the vessels. Also, when the time came for launching, the vessels could be simply floated by letting water into the basins until the level coincided with that of the adjoining Casco Bay. Then the vessels could be towed out of the sunken basins by tugs for transferring to an outfitting dock. There would never be the danger of a ship capsizing while being launched, nor the necessity of spending large sums of money for greasing ways, knocking out supporting blocks, and other incidentals required in launching from ways.

In carrying out this unusual plan, huge basins were dug from solid ground—large enough for the simultaneous construction of seven ships. Actually there are three basins, one of which has a capacity for holding three ships at a time, and the others, two vessels each. These basins are all approximately 500 feet long by 18 feet deep. The largest is about 270 feet wide and the others 180 feet wide. The heading illustration shows a view along the bay end of two sunken basins which have been flooded preparatory to the launching of five cargo vessels as soon as gates and catwalks are lifted from the front end of the basins. The lifting is accomplished by the use of the adjacent gantry cranes.

Until the time for launching occurs, the basins are entirely empty of water, allowing workmen complete freedom in the construction of the vessels from the keel up. In front of the bow of each ship in a basin are six bulkhead-like gates which are fitted into vertical structural members, connected at the top to a horizontal beam that supports a catwalk between concrete piers, and at the bottom to another horizontal beam that completes the gate-holding structure. The span between the concrete piers is about 80 feet.

When the time comes for launching, valves are opened to allow the water from the bay to gradually fill the basin. Then, at low tide, when the pressure of the water against the gates is at a minimum, the gates of the basin, as well as the catwalk and the structural frame that ordinarily holds the gates in place, are pulled up by gantry cranes. When high tide is reached, the vessels can be readily pulled out of the basin by tugs. Actually, the gates do not extend to the full depth of the basins, permanent walls being erected beneath the gates to a height of approximately 4 feet above the floor of the basin.

This Todd-Bath shipyard was originally constructed for the building of vessels for the British Ministry of Shipping. The contract with

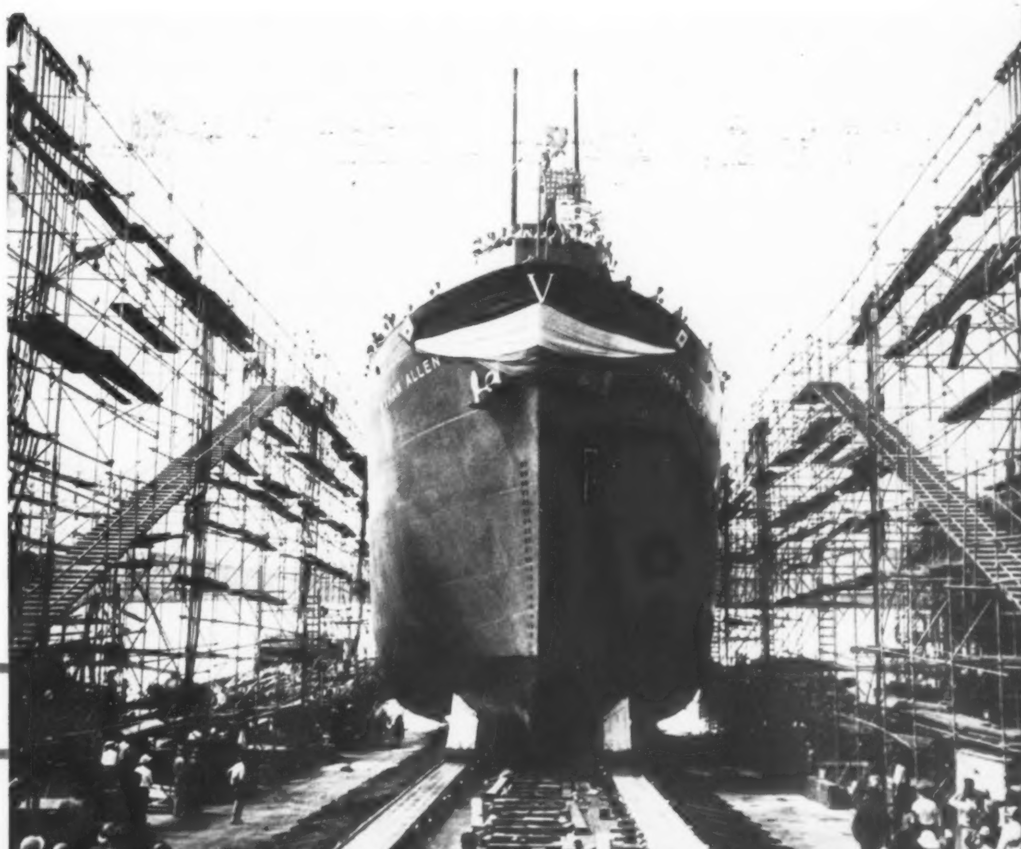


Fig. 1. Ships are Built on Ways in the Conventional Manner at the S. Portland Shipyard. Steel-pipe Scaffolding is Used at the Ways, as also in the Todd-Bath Basins

the British Government having now been completed, the combined facilities of this yard and of the South Portland Shipbuilding Corporation are now devoted entirely to turning out Liberty ships. The latter yard was developed on the conventional principle of building ships on ways, and it is provided with six ways.

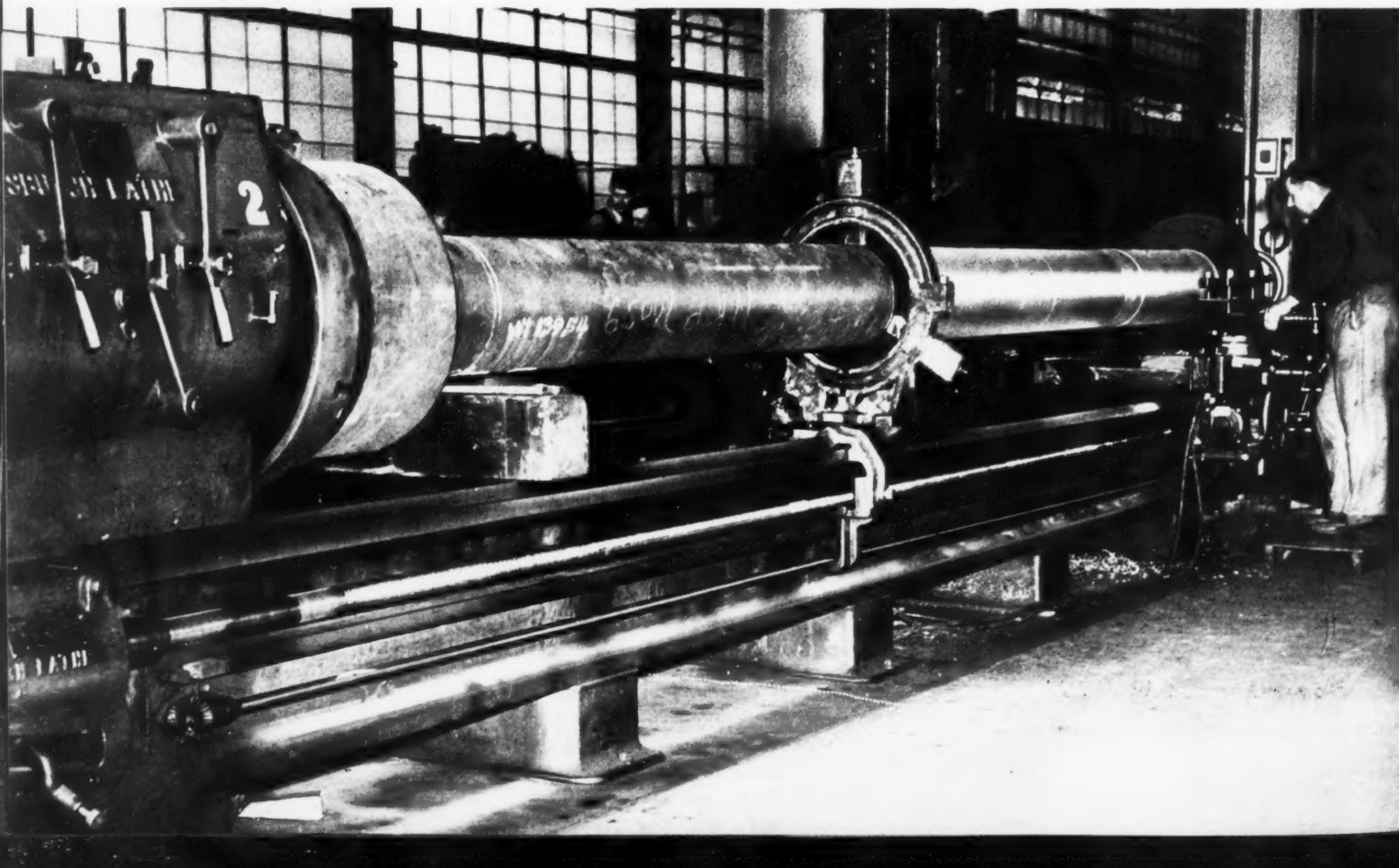
It is anticipated that the output of the two yards will soon attain the rate of one ship every four and one-half days. There are about twenty-six thousand employes in both yards.

A feature of both the shipbuilding basins and ways of these yards is the complete use of steel piping for scaffolds. This type of scaffolding provides ready flexibility, is easily erected or disassembled, and lasts indefinitely. Ship production in these yards is based on prefabrication of as many units as possible prior to the delivery of any material to a way or basin. Plates are cut to the required outlines in the shop and then transferred directly to fabricating points in the shop or in convenient locations about the yard, where they are fabricated by welding into inner bottoms, bulkheads, hatches, and so on. These large weldments are transported by trucks, cranes, and even barges to the ways and basins. Within recent months, a fabricating shop has been erected at a central point between the two yards to handle the overflow fabricating activities of the yards.

It will be apparent, therefore, that these yards operate on the mass shipbuilding production principle that came into vogue with the present war. In general, individual manufacturing operations are similar to those found in other shipyards. Some of the more interesting operations—particularly in the machine shop—are illustrated in this article. Several large engine lathes are employed in the machine shop for turning operations on ship propeller shafts. Six sections, each approximately 22 feet in length, comprise one propeller shaft. In Fig. 2, a Pittsburgh engine lathe of 36 inches swing, provided with a 30-foot bed, is shown engaged in turning a propeller shaft. Two bearings are being turned to a diameter of 13 3/4 inches, and a portion of the shaft between the bearings to a diameter of 13 1/2 inches.

All diameters must be held to the specified size within plus or minus 0.002 inch, and the shaft must be straight from one end to the other within 0.002 inch. Tantung carbide-tipped tools are used in rough-turning, and Rex MM in semi-finish and finish turning. Stock to a depth of 3/16 inch is removed in the roughing cut. The shaft section shown weighed 7 tons in the rough,

Fig. 2. Turning a Propeller Shaft Section that is 22 Feet Long and Weighs Seven Tons in the Rough



...and on Ways

Fig. 3. The Flanges on the Ends of the Propeller Shaft Sections are Drilled and Bored Accurately as to Center Distance on a Horizontal Boring and Drilling Machine by the Use of a Jig Plate

and 6 tons when it left the lathe. The lathe carriage is equipped with an individual motor drive for quick traversal along the bed, the motor driving a pinion that engages a rack extending along the under side of the front bedway.

Large holes are drilled and bored in flanges at the two ends of these propeller shaft sections on the Footburt horizontal boring and drilling machine illustrated in Fig. 3. As the specified center-to-center distances between the holes must be closely maintained, a circular jig plate is mounted on the flange as shown. After the work has been set up in this manner and before any hole is drilled, the correct location of the machine spindle relative to any jig bushing is determined by mounting a cylindrical plug in the machine spindle and feeding the plug into the jig bushing. This plug is slightly smaller in diameter than the jig bushings, so that while the plug is revolved in a bushing, a feeler can be applied to determine whether the plug is revolving concentrically within the bushing.

When the proper location of the machine spindle is insured, a 3 5/16-inch diameter drill is fed through the drill bushing and the flange as shown. Then the hole is bored to 3 7/16 inches

Fig. 4. Bolts to Fit the Holes in the Propeller Shaft Flanges are Turned and Threaded in the Engine Lathe Here Shown

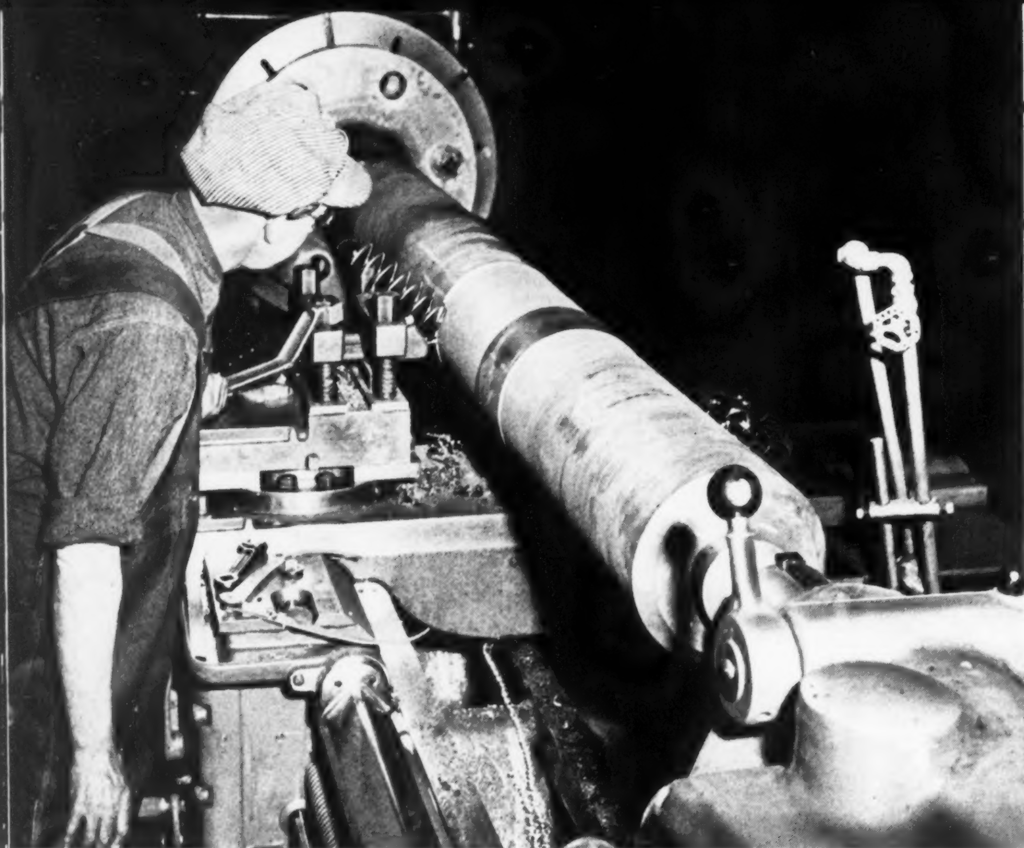
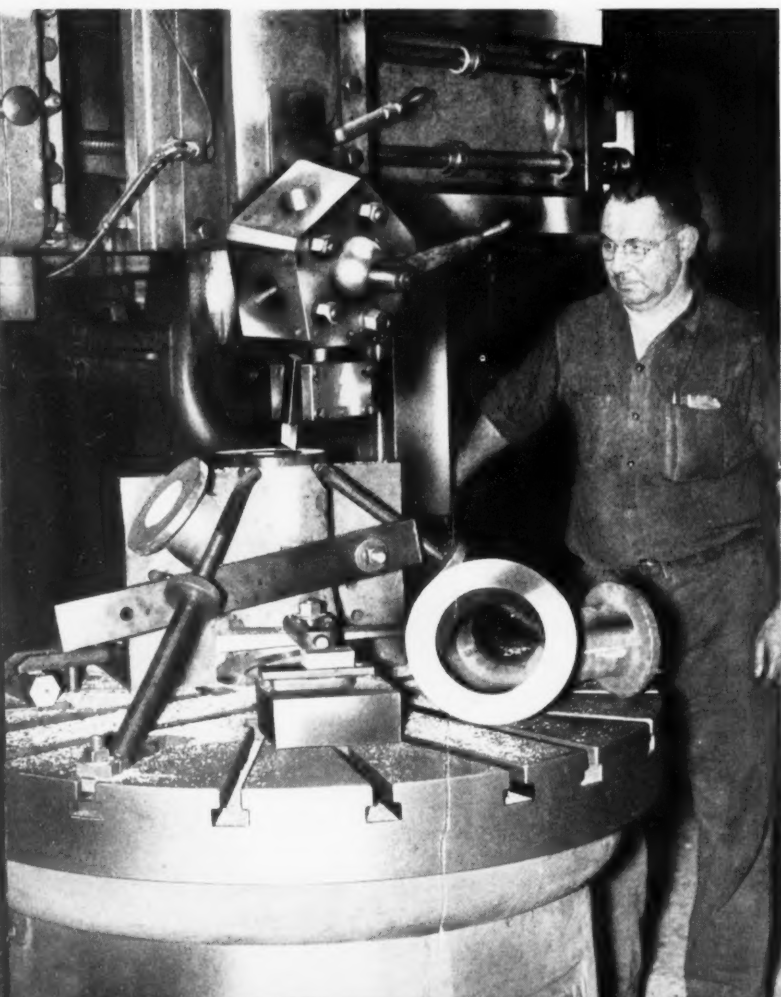


Fig. 5. Machining Fits for the Rudder Bearing and Steering Quadrant on a Rudder Stock in a Heavy-duty Engine Lathe

Fig. 6. Vertical Boring Mill of Medium Size being Used for Turning, Facing, and Back-facing the Flanges on Pipe Couplings



in diameter by substituting for the drill one of the boring-bars seen resting on the front of the table. One of the other tools on the table is finally used for back-facing the flange around the hole. Thus each of the six holes in a flange is drilled, bored, and back-faced.

Bolts for fastening together the flanges of the sections of a propeller shaft are machined from pieces of bar stock of the required length in the American engine lathe illustrated in Fig. 4. These bolts are closely machined to a diameter of 3 7/16 inches to accurately fit the flange holes. The thread on the bolts is cut to 2 3/4 inches in diameter, and there are four threads per inch. The over-all length of the bolts, not including the head, is 6 3/4 inches.

Cylindrical surfaces are being turned on a rudder stock by the Axelson engine lathe seen in Fig. 5, which has a swing of 32 inches and handles work up to 168 inches long between centers. The surfaces being machined are fits for the rudder bearing and the steering quadrant. The rudder bearing fit, near the center, is turned to a diameter of 9.248 to 9.249 inches for a length of 9 1/4 inches, while the steering quadrant fit, at one end, is turned to a diameter of 9 1/4 inches for a length of 21 3/4 inches. A roughing cut 1/8 inch deep is taken by a Tantung cutter. The over-all length of the rudder stock is 105 3/4 inches.

A Colburn vertical boring mill equipped with a table 62 inches in diameter is used for a large

and Todd-Bath

Fig. 7. Shaping a Ship Door with a Solid Cylindrical Punch and a V-type Die on a 200-ton Hydraulic Press

variety of work. In Fig. 6 this machine is shown being used for facing and turning the flanges of triple-flange cast-bronze couplings. Both the front and back faces of all three flanges are finished, there being a tolerance on the flange thickness of plus or minus 0.001 inch. The work is held on an angle type fixture, and must, of course, be set up in three different positions for machining all the flanges.

One of a battery of Rogers vertical turret lathes of 32 inches swing is shown in Fig. 8 performing a similar operation on cast-bronze manifolds for fire and bilge pumps. These manifolds have five flanges, all of which are turned and faced. A flat pad on the manifolds is also faced for mounting an eye level fitting.

In the plate shop of the Todd-Bath yard, a Farquhar hydraulic press of 200 tons capacity is used for bending plates and structural shapes of large variety, including keel plates. Fig. 7 shows this machine bending a plate for a door. The punch or upper die consists simply of a round bar, 6 inches in diameter by about 2 feet long, which is welded to a heavy plate that is attached to the press ram. The bottom die is a heavy V-block.

In the plate shop of the South Portland yard, the Southwark hydraulic press illustrated in Fig. 9 is employed for similar work. This press is provided with four rams of 100 tons capacity each. Two of the rams are positioned vertically above the table, one vertically below the table,

Fig. 8. Employing a Medium-sized Vertical Turret Lathe for Machining Flanges on Fire and Bilge Pump Manifolds

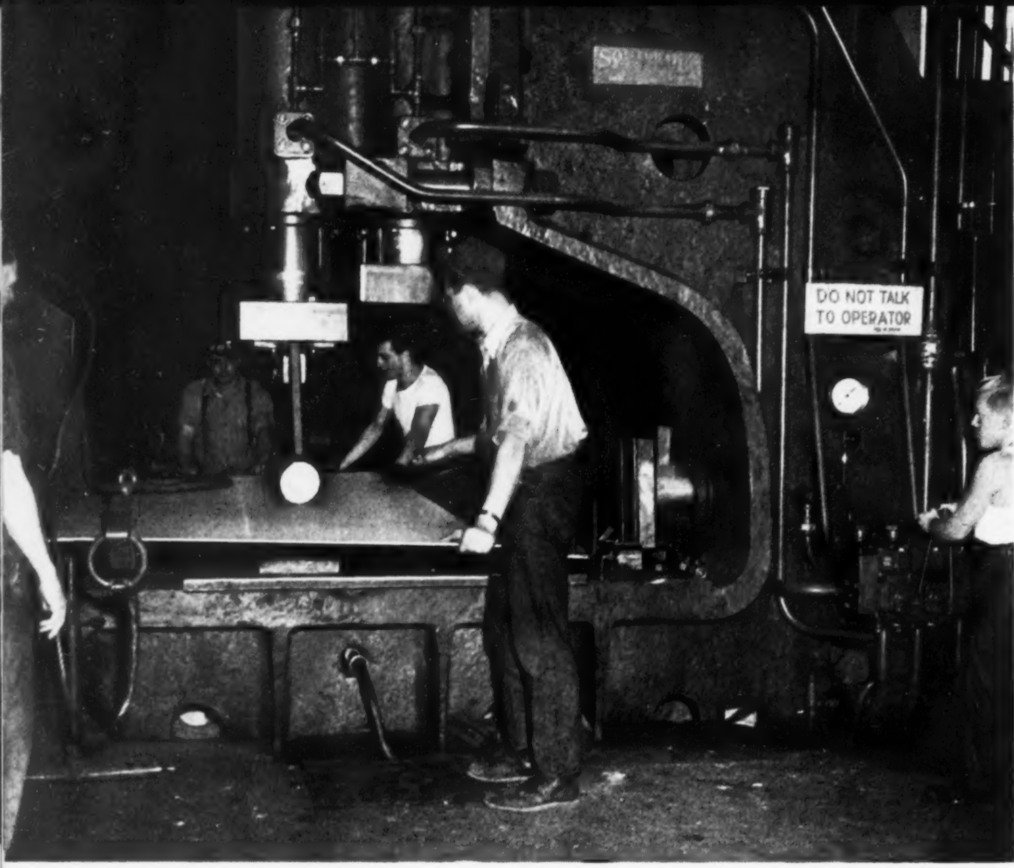


Fig. 9. Four-ram Type of Hydraulic Press that is Used for a Great Variety of Bending Operations on Plates up to 1 Inch Thick

and one horizontally, extending forward from the machine column. Plates up to 1 inch thick are bent with this press, while plates up to 4 inches thick are straightened. At the time that the photograph was taken, a plate was being formed into an escape trunk. The upper die member is similar to that used on the Farquhar press.

Many pieces of light gage, including steel plates up to 1/4 inch thick, are bent to square corners by means of press brakes. Fig. 10 shows a Dreis & Krump brake with a ram 10 feet long engaged in a typical operation. Such ship members as degaussing channels, ventilation ducts, transition pieces, cabinets, and lockers are formed with this type of equipment. The die members in the operation illustrated are of opposite vee designs.

Ship plates are cut out to the required outlines by the use of oxy-acetylene machines of the Travograph, Radiagraph, and Oxygraph types. In Fig. 11, an Oxygraph machine, equipped with ten torches, is being used for simultaneously cutting out a like number of pieces as a magnetic tracer automatically follows the outline of a steel templet. Paper tem-

Fig. 10. Press Brakes are Used Extensively in the Straight Bending of Steel Plates up to 1/4 Inch in Thickness

and Todd-Bath

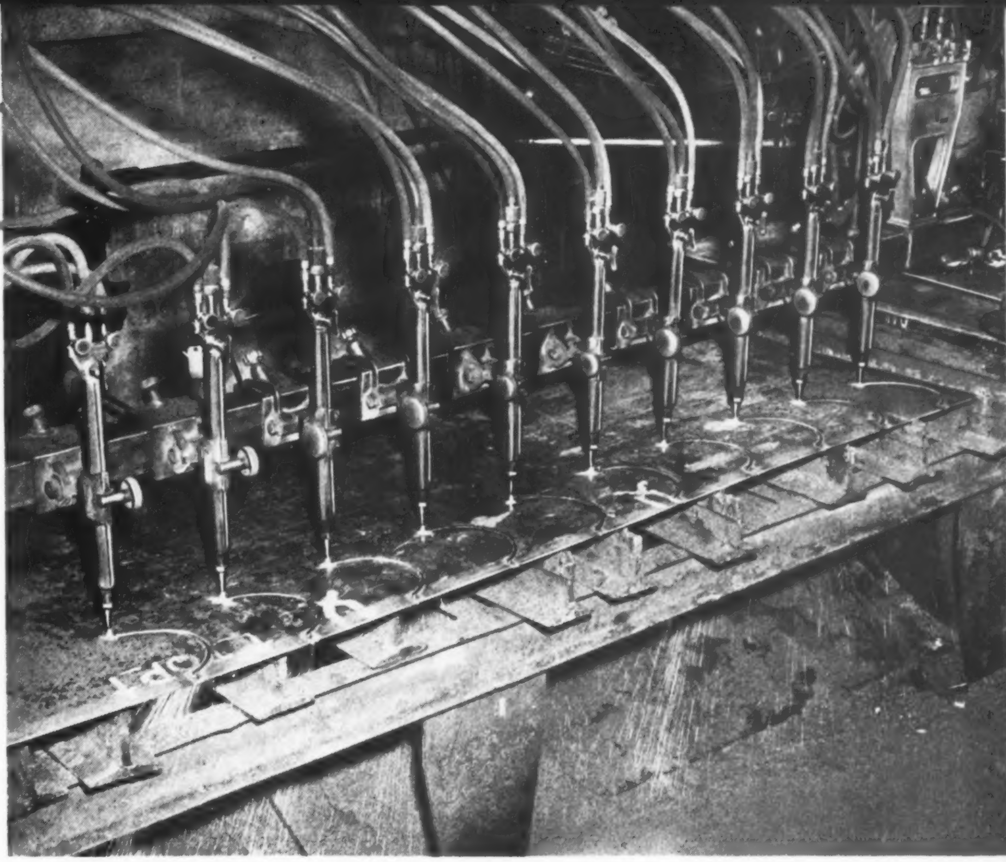


Fig. 11. Ten Torches on This Automatic Oxy-acetylene Machine Cut out Ten Pieces to the Outline of the Templet Seen at Extreme Right

plets are also used, in which cases the tracing device is guided manually. This high-production method is used in cutting out such pieces as deck hooks, wedges, dogs, chain plates, and gun-deck foundation washers.

A typical operation in the pipe shop is the cutting of pipe to length and threading the ends to receive couplings. Fig. 12 shows an Oster machine used for this purpose, which cuts pipe from 1 1/2 to 8 inches in size, and threads pipe from 2 1/2 to 8 inches. The cutting tool is mounted on a slide at the front of the machine, as shown, and is simply moved horizontally into the revolving pipe in cutting a piece to the required length. One set of dies, mounted in an adjustable head, is sufficient for cutting all thread sizes within the range of the machine.

Fig. 12. Pipe Cutting and Threading Machine being Used for Cutting a Section of 8-inch Pipe to Required Length

Ship Chains Made by

SHIPS FOR VICTORY

Semi-Automatic and Automatic Methods Employed in a Mid-Western Plant which Produces Chain for Ships being Built by the Maritime Commission

Approved for Publication by the U. S. Maritime Commission

CHAIN is an indispensable item aboard ship. Not only is it used for lowering and raising anchors, but for a hundred and one other purposes, such as railings on companion ways, hatch guards, anchor falls, hoisting equipment, steering gear, etc. As hundreds of fathoms of steel chain are required for every sea-going vessel, the huge shipbuilding program of the United States Maritime Commission and the United States Navy demands virtually the complete output of concerns who normally are engaged in the manufacture of chain for peacetime purposes.

Among these concerns is the S. G. Taylor Chain Co., Hammond, Ind., which produces chain for ship use from solid steel bars. Two principal manufacturing methods are used—fire welding and electric welding. All of the chain is produced to specifications of the Maritime Commission, dimensions, weight, and strength being held to these specifications within 4 per cent.

The fire welding, or older method, will be de-

Fire Welding and Electric Welding

scribed first. In this method, stock in the form either of long straight bars or large-diameter coils is wound into spring-like coils of small diameter on machines like that illustrated in Fig. 1. For this operation, the end of the bar stock is threaded between a mandrel attached to the spindle of the machine and a lug on a dog that is slipped over the mandrel. Then a roller attached to the front end of the hinged bar seen in the illustration is brought down on top of the dog to apply a heavy downward pressure.

When the machine is started, the dog causes the stock to be bent around the revolving mandrel, and as the coil is formed, the dog slips along the mandrel with the coil, as indicated in the illustration. After the dog passes from under the roller, pressure is exerted directly on the stock, so that it is bent closely to the shape of the mandrel. Clamping of the pressure roller on the stock is accomplished through a large cam in the bottom of the machine, which is controlled by a foot-pedal. Wood shavings are heaped on the revolving pressure roller and the stock to facilitate the operation. The operation can readily be performed cold on low-carbon, hot-rolled, mild-steel stock. At the time the photograph was taken, 3/4 inch stock was being handled.

The coils are formed to suit the dimensions and shape of the links to be made from them. In many instances, the links are to be rectangular in shape rather than circular, and in those cases the mandrels have a rectangular cross-section. Usually the coils are produced in lengths not exceeding 5 feet, so that they can be conveniently handled in the succeeding operation.

The individual links are snipped from the coiled lengths on vertical shears, such as that shown in Fig. 2, which is equipped with shear blades 3 inches wide, ground to an angle of about 30 degrees. The operator holds the bottom of the coiled stock with his right hand while he slips the front end of the coil over the bottom shear blade and its holder, so that the links are sheared along the top of the coil at an angle, as seen by the individual links lying on the floor. There is no danger of injury to the operator, because his hands never come in contact with the moving shear blade.

Links produced by the methods described are made into continuous chain by heating to a forging temperature and then fire welding into closed links. The links are heated either in oil-fired furnaces or in coke-fired furnaces (see Fig. 4). In the coke furnaces, the sheared links are loaded on a steel bar chute that extends upward from the right-hand side of the furnace at an angle

Fig. 1. Winding Chain Stock into Coils of Comparatively Small Diameter, Ready for Cutting into Individual Chain Links

Fig. 2. (Left) Shearing Chain Links from Coils of Bar Stock Produced in the Manner Shown in Fig. 1

Fig. 3. (Below) Type of Equipment which Automatically Produces Lengths of Chain by Cutting off Short Pieces of Bar Stock and Forming Them through Preceding Links

as shown, completely across the top of the fire and out through the left-hand wall. The links slide down this chute by gravity and reach a door at the left-hand side of the furnace at a height slightly above the fire.

Here the forge man takes the links off the end of the chute and buries them, one at a time, completely in the fire, so that they reach almost a white heat by the time that he has welded another link previously removed from the fire. In the welding operation, he first dips the heated stock in sand to obtain a flux, and then slips the split link into a link that has previously been closed on the chain that is being forged. The forge man then strikes several blows on the heated stock with a hand hammer to start closing the split ends. Next he places this link on the anvil of a power-driven hammer, such as seen in the heading illustration, which is equipped with a die-block having a projecting lug, shaped on one side to suit the rounded contour on the inner side of the link at the point opposite the split end. The power hammer strikes a succession of blows on the split end by means of a die attached to the hammer head. This die is shaped to suit the contour of the link around the outer edge. During the successive strokes of the hammer, the forge man turns the link upside down

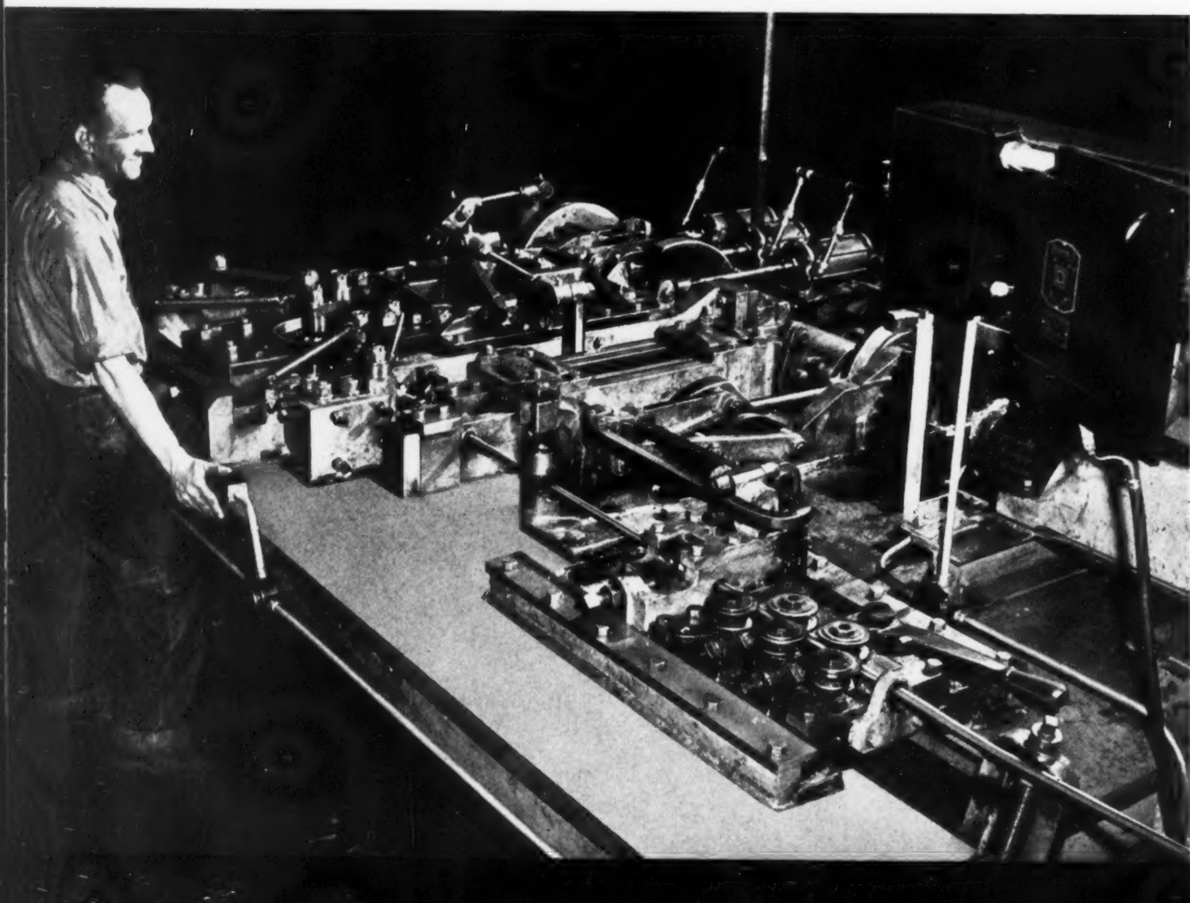


Fig. 4. Fire Welding Sheared Chain Links by Pounding Them under a Power Hammer after They have been Heated to Forging Temperature

on the die until a satisfactory scarf weld has been obtained.

The power hammer is of simple design, the hammer head being hinged at the back of the machine and ordinarily held in a raised position by means of two dogs that engage locking pins which project from both sides of the hammer head. When a foot-treadle is released, the hammer head drops forward by its own weight to strike a blow on the anvil. It is repeatedly raised by two cams on a revolving shaft, and permitted to drop as these cams pass rollers on the sides of the hammer head. The cams can be clearly seen in the heading illustration. A heavy coil spring at the back of the machine, which is connected to the hammer head, aids the quick downward blows of the hammer. As the successive links are fire welded, the chain is pulled up over a sling that is suspended from the ceiling, until the desired length of chain has been obtained.

In Fig. 4 and in the heading illustration, 1 1/4-inch stock is being forged into links that are approximately 6 inches in over-all length by 4 inches in width. Between operations the forge man dips his tongs into water to keep them cool, and water is run constantly down over the furnace door for cooling purposes.

Fig. 5. The Chain Links Formed by the Machine Shown in Fig. 3 are Automatically Butt Welded in This Machine

Ship Chains Made by Electric and Fire Welding

Both flash and butt welding are employed in the production of electrically welded chain. Links for chain to be butt-welded are formed from bar stock on automatic machines, one of which is illustrated in Fig. 3. In this machine, the material is first straightened, then cut off to the proper length to make one link, and bent around a mandrel. After the link is formed, it is removed from the mandrel and placed in position to receive the next link blank. This operation makes formed chain in continuous lengths.

The chain is next taken to the machine shown in Fig. 5, which automatically welds successive links as they pass electrodes in the vertical plane. After the welding is completed, swaging arms come into contact with the link to reduce the swelling caused by the welding to the original link stock size. This leaves surplus metal on the inside and outside of the link where the welding takes place. The excess metal is then sheared off by the machine. It is necessary to run the chain through the welding machine twice, so that the links which were in the horizontal plane during the first passage through the machine can be welded at the second passage through the machine.

Chain is also produced in this plant by flash welding together two U-shaped pieces of steel stock to form the individual links. This method can be employed with steel bars having a carbon content up to 0.50 per cent, and also with bars of alloy steel.

In the flash-welding process, the two U-shaped pieces are placed on the vertical faces of electrodes on the machine shown in Fig. 6, with the open ends of the half links extending toward each other, and with one U-shaped piece inserted through the last link that was previously welded on the chain. One end of the machine is stationary, and the other advances slowly until an electric arc is struck between the two halves of the link. Material is actually burned away in maintaining this arc. The heat spreads back from the ends of the link to be welded. When sufficiently heated, heavy pressure is exerted through the movable end of the machine to make the weld. The operation is entirely automatic from the time that the arc is struck until the weld is completed. Making the weld on both sides of the link eliminates any possibility of stress being put on the weld.

The flash that is built up in welding is sheared off in a succeeding operation performed on a mechanical press. Any length of chain can, of course, be produced by this method, as well as by the methods already described.

Fig. 6. View of One of the Flash-welding Machines in which Chain Links are Produced from Two U-shaped Pieces, Such as Seen Lying on the Electrode Housing

New Tin-Free Gear Bronze

An Important War-Time Development

THE Hamilton Gear & Machine Co., Toronto, Canada, with the cooperation of O. W. Ellis of the Ontario Research Foundation, has developed a new tin-free bronze that is not merely a substitute for the gear bronzes used in the past, but is actually superior to the conventional metal when used as a worm-gear bronze.

In endeavoring to find a substitute for gear bronzes containing tin, the object was to find an alloy which, when used as a worm-gear, would have high load-carrying capacity, as regards both strength and resistance to wear, and which would operate at a moderate temperature rise. In developing this bronze, all tests were made with worm-gears mated with hardened and ground steel worms, rigidly aligned in enclosed speed reducers, with oil-bath lubrication.

Some ten years ago, the Hamilton Gear & Machine Co. engaged in thorough research on all phases of worm and worm-gear design, including the materials to be used. At that time it was decided that the best gear bronze was a copper-tin-nickel alloy containing 87.5 per cent copper, 11 per cent tin, and 1.5 per cent nickel. This alloy resembles the S A E 65, with the addition of nickel.

Since this gear bronze had proved exceptionally satisfactory, it was a serious matter to find that tin would no longer be available on account of war conditions, and that it had become necessary to find a substitute. In succession, all the known copper alloys, except beryllium copper, which is not commercially available, were tried. Special attention was given to several trademarked bronzes known to be good for other purposes than gears. A satisfactory solution was not found, however, and therefore a large number of combinations of all the commercially available alloying metals were tried until the problem was successfully solved.

Results of Experiments Undertaken

It was found that the aluminum bronzes were not so good for bearing metals as the tin bronzes; and when they failed, they had the unfortunate characteristic of damaging the worm. The copper-silicon and copper-silicon-iron groups proved failures for the purpose for which the alloy metal was required. So did also copper-nickel-zinc and copper-nickel-lead alloys, as well as many others. The copper-nickel-silicon, copper-nickel-silicon-silver, and copper-aluminum-antimony alloys gave moderately successful results. These alloys could qualify as substitute materials.

Finally, however, a combination was found that proved really valuable—a copper-nickel-antimony alloy. In fact, this proved to be better for worm-gear purposes than the peace-time bronze. Chester B. Hamilton, Jr., president of the Hamilton Gear & Machine Co., says that he is not yet prepared to make any statement about the value of this bronze for other purposes than worm-gears, or for applications where shock is involved, because tests have not been completed in these directions.

Composition and Properties of the New Gear Bronze

The alloy consists of from 7 to 8 per cent antimony, from 1.5 to 2.5 per cent nickel, and the remainder copper. A peculiarity of this metal is that it has never been found to pit or spall. When it fails, it is by simple abrasive wear of the surface. Roughly, worm-gears made from this metal will carry about 25 per cent more load than tin bronze, or will run about 15 degrees F. cooler at the same load. The reason for this may be in the micro-structure. C. H. Bierbaum, noted metallurgist, has made and tested some samples of this alloy, and reports that it has a triplex structure, composed of three constituents of widely different micro-hardness. It has long been known that a duplex structure is essential for a good bearing metal. Possibly a triplex structure is still better.

The ultimate strength of this bronze averages 31,900 pounds per square inch; the elongation, 7 1/2 per cent in 2 inches; and the reduction in area, 15 per cent. The yield point (limit of proportionality) averages 19,000 pounds per square inch.

With the usual copper-tin-nickel bronze, the gears were cast in a chill-ring, which resulted in a considerably better product than when the gears were cast in plain sand molds. For that reason, all the tests on the copper-antimony-nickel alloy were made in duplicate, chilled and unchilled. It appears at present that chilling this metal does not improve it; a plain sand-cast gear is just as good.

The Hamilton Gear & Machine Co. announces that no patent has been applied for on this alloy, nor are there any restrictions imposed on its use. The company wishes to make this discovery a gift for the benefit of the Allied Nations.

Gear Manufacturers Consider War Production Problems

THE problems created by war conditions received a large part of the attention at the twenty-fifth semi-annual meeting of the American Gear Manufacturers Association held at Skytop, Pa., October 15, 16, and 17. As usual, standardization in the gear industry was also a major topic of discussion. The meeting was opened by the Association's president, John H. Flagg, president of the Watson-Flagg Machine Co., Paterson, N. J., who briefly outlined the reasons for holding a meeting at this time and the importance of the problems to be discussed.

John H. Flagg, President of the American Gear Manufacturers Association

Two important technical papers were presented. One of these was on "Design and Manufacture of Aircraft Engine Gearing." This paper was prepared by P. W. Brown, assistant works manager, and Earle V. Farrar, staff engineer, of the Wright Aeronautical Corporation. An abstract of this paper will be found on page 219 of this number of MACHINERY. The other paper, entitled "Substitution of War Materials as a Necessary Aid to the War Effort," was presented by E. J. Wellauer, supervisor of research and metallurgy of the Falk Corporation. This paper is abstracted on page 226.

Industry's Part in the War Effort

At one of the sessions, Howard Dunbar, vice-president of the Norton Co., addressed the meeting. Mr. Dunbar concisely reviewed the performance record of several industries, pointing out how remarkable has been the showing in machine tool production and aircraft, to mention only two of the industries that have done their job so creditably.

Referring to the much abused word "bottleneck," he asked the question "What is a bottleneck in industry?" and answered it in this manner: When more is demanded of an industry than its manufacturing facilities make it possible to produce, then that industry is called a bottleneck. The machine tool industry, in the early part of the defense manufacturing program, doubled and tripled its former maximum peace effort; yet, when ten times as much as that maximum peace effort was demanded, obviously a bottleneck was created. At the present time, the machine tool industry is producing at a rate eight times greater than its largest peace production, and at a rate sixteen times as great as its average production for the ten years previous to the outbreak of the war; yet it is not able to deliver quite so rapidly as the machinery manufactured can be absorbed.

While Mr. Dunbar specifically mentioned the machine tool industry's record of production, he stated that many other industries, like the gear industry, the pump industry, the ball and roller bearing industry, etc., had also responded remarkably well to the emergency.

Another subject dealt with was the problem created by the shifting requirements in the conduct of the war. As the war progresses, new demands are placed upon industry. We should recognize that this is not due to lack of planning, but because the shifting conditions of warfare on land and sea may require emphasis on a different kind of equipment tomorrow from that which is mostly in demand today. Thus, from time to time, the emphasis may be on aircraft, on ships, on tanks, or on artillery.

During his address, Mr. Dunbar also mentioned the outstanding performance of the automotive industry. In less than a year, this industry has switched from producing passenger cars and trucks to building tanks, guns, shells, and bombers in great quantities. He also paid a tribute to the railroads for performance in handling, in addition to their regular peacetime traffic, the tremendous traffic created by war conditions, both in passenger and freight transportation. To a large extent, too, the railroads have had to assume the moving of freight that usually is transported by water. All this has been done by the railroads under private manage-

ment, adding another evidence to the efficiency that can be achieved when private management is left alone to work out its own problems.

An indication of the tremendous war production of the United States was referred to. This country produces almost as much steel as all the rest of the world combined, and practically all of this is now being used directly or indirectly for the manufacture of things required for the conduct of the war. It is obviously necessary to properly allocate and distribute this steel; but when so distributed, there is no real scarcity, provided steel production is maintained.

Mr. Dunbar then made reference to the effect of Government control of industry. "In private industry," he said, "we give a man a job and expect him to do it." Government should have done just that with industry. It should merely have said to industry, "Here is the job to be done; go ahead and do it." But, instead of that, Government began to give explicit directions as to shifts, number of hours to be worked, wages to be paid, etc. Yet, frequently orders were not placed fast enough to get all plants started on war work as fast as they were able to start.

Referring to the impatience of certain groups of citizens with the war effort and the slowness of the completion of the manufacturing program, Mr. Dunbar said that the obvious thing is easy to do and takes the least amount of time. The difficult thing takes a little longer; and the impossible, which American industry has actually achieved, takes longer still, but it is being done. With all the difficulties that it has had to contend with, industry has done its job and done it well.

America Must Awake to the Seriousness of the War

In a stirring address delivered by Chester H. Lang, vice-president of the General Electric Co., the speaker emphasized how little the American people as a whole realize the seriousness of the war in which we are engaged. He called upon everyone to act as if the outcome of the war depended upon his or her personal efforts. We are fortunate that we are not immediately threatened by invasion, but, on the other hand, a nation like England that has been and is so threatened, has exerted itself far more than we do to resist and conquer the enemy. We still have interruptions in our war effort—now here, now there—due to the selfish interests of groups of citizens. It is time to realize that united effort is required, and that differences between political factions, between employer and employes, and between advocates of different economic systems, can wait until we are safely at peace.

Results Obtained by Simplification of Design of War Equipment

The Ordnance Division of the War Department recently published a booklet containing numerous examples indicating how, by slight changes in design of various ordnance items, simpler manufacturing methods and more generally available materials can be substituted for the methods and materials formerly used. A few of these examples will indicate the great savings possible through such changes. They will suggest where similar changes can be made in other equipment and stimulate thought along simplification lines that will speed production and reduce costs without any change in the usefulness of the product.

The Army Ordnance booklet, for example, mentions how, by changing a lug used on bombs from a forging to a pressed-steel part so that it could be produced on otherwise idle stamping presses, 17,000 pounds of steel and 8000 machine-tool hours were saved on one lot of 100,000 pieces. Furthermore, thousands of bombs that were waiting for forged lugs could be completed immediately.

In another case, 3.85 pounds of steel bar and 0.23 machine-hour were required to produce an adapter weighing 1.81 pounds in its finished state. This adapter is now made from a pressed-steel bar. The saving, in making 1,500,000 adapters from pressed steel, is enough for over 3000 one-ton bombs. Furthermore, 210,000 machine-tool hours are saved and 25 automatic screw machines are released in two ordnance districts alone. To offset this saving, 3500 pounds of copper are used in the hydrogen-copper brazing of the pressed adapters, but this is a small item compared with the savings that are accomplished in other directions. The booklet, entitled "Tremendous Trifles," may be obtained from the Manufacturing Process Section, Production Division, War Department, Pentagon Building, Washington, D. C.

* * *

Approximately 1000 pounds of scrap goes into the making of a 75-millimeter field gun; 50 pounds of scrap goes into the making of a 0.50-caliber machine gun; while 36,000 pounds of scrap is required to make the steel necessary for building a medium sized tank.

EDITORIAL COMMENT

Scrap Metal is Now as Necessary as the Ore of the Mines

How extremely critical the collection of all kinds of iron and steel scrap has become is well exemplified by the fact that the steel rails of obsolete street car systems and interurban railroads, for years buried in streets and roads —under asphalt and concrete pavements—are now being dug up in order to recover the rails to provide the steel mills with an adequate supply of scrap iron. The actual market value of these scrap steel rails is about $18 a ton, but it will generally cost over $50 a ton to recover them, since pavements must be torn up and replaced at considerable cost.

The Metals Reserve Corporation and the Industrial Salvage Section of the War Production Board are engaged in many projects aimed at the salvaging of metals, especially iron and steel scrap. There is a drive under way now to locate scrap material in every industrial plant throughout the country. A great number of men have volunteered to serve the Government in this work by systematically visiting industrial plants to confer with the management and to cooperate with industrial executives in ferreting out machines and materials that at present serve no industrial purpose and that may be charged into the cupola or Bessemer converter.

Old Machines Will Serve Best as Useful Scrap

The scrapping of many old, obsolete machines will serve a useful purpose, entirely apart from their value as scrap metal. American industry has been burdened by a great deal of obsolete manufacturing equipment that could be used only in an inefficient manner and with a waste of time and money when operated. To the extent that American industry will come out of the war better provided than ever with modern machinery, and freed from a great deal of the equipment that should have found its way to the junk yard long ago, the war has served a useful purpose.

Industrial managers are requested by the War Production Board to lend every possible assistance to the representatives of the Industrial Salvage Section when they call to aid in scrap collection. Almost every shop has a number of obsolete machines that have practically stood idle for years; tools lying on the shelves of the store-room that have not been in use for a decade and that may never be used again; jigs and fixtures no longer required because the parts in the manufacture of which they were used are no longer made; and piles of scrap metal, spoiled parts, etc., that should be loaded on trucks or railroad cars to become, through the medium of the steel mills, parts of tanks, guns, and ships.

An adequate supply of steel cannot be produced without an adequate supply of scrap; that is why scrap metal is now receiving so much attention. It has become one of the bottlenecks. If the flow out of the scrap-metal bottle is steady and ample, the war will be won that much sooner.

War Material Must be Properly Packed for Shipment

One of the important matters to which the management of plants engaged in war equipment manufacture must pay attention is that of properly packing the manufactured items for shipment after they have been completed, inspected, and accepted by the Government. No matter how carefully and accurately various war equipment items have been manufactured, if they are not so packed that they can be transported without injury to any place in the world where they are to be used, the care in manufacturing is of little avail. The Packing and Crating Unit of the Production Division, Services of Supply, Office of the Chief of Transportation, War Department, Washington, D. C., is prepared to give manufacturers assistance and advice in regard to packing problems. The importance of the subject has led the Government to investigate the subject thoroughly, and to prepare manuals that are of great assistance to industry. These manuals may be had by any war-work manufacturer on request to the Division mentioned. They give information in great detail.

Machine Tool Builders Discuss Problems Caused by War

THE forty-first annual convention of the National Machine Tool Builders' Association, held at the Waldorf-Astoria Hotel, New York City, October 5 and 6, was attended by an unusually large number of representatives of the member companies. Considering the grave industrial problems created by the war, this was to be expected, since the meeting was devoted entirely to discussions of matters directly related to war production conditions.

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John S. Chafee, New President of the National Machine Tool Builders' Association

The meeting was opened by the president of the Association, George H. Johnson, president of the Gisholt Machine Co. In his opening address, Mr. Johnson called attention to the accomplishment of the machine tool industry during the past year, and the importance of surpassing that record. He said: "With a year of incredible volume of output behind us, I state to you most emphatically that the need for still greater production remains acute and immediate. . . . It is vital that we put on all speed to build the balance of the machine tools required to place our national war production facilities on a maximum production basis. We must do this in the face of increasing difficulties with respect to both personnel and materials.

"Our capacity to maintain maximum output has already been seriously handicapped by the draft situation. It seems highly probable that, as time goes on, most of our eligible men under the age of forty-four, except those in key positions, will be drafted into the Armed Forces. As far as I can see, the only practicable solution lies in the employment of trained women. This is already well under way in a good many plants, and I think it will, without doubt, become a universal practice.

"The materials situation will probably grow more critical as time goes on. The point I wish to bring home is that we are today in this situation: Our total capacity to fabricate materials is actually greater than our total supply of available materials. This, in time of war, is not only healthy, but absolutely necessary. We must be able, quickly, if such need should develop, to shift production emphasis from planes to tanks, to guns, to ships, to whatever particular type of production seems critically important at the moment. We cannot do this unless we have a sum total of fabricating capacity larger than that required to handle the available supply of materials. . . . We must make enough machine tools so that, when the peak demand occurs in a particular branch of the war production program, the peak demand may be met. Furthermore, we must make these machine tools right now, just as fast as we can."

Captain E. R. Henning, of the United States Navy, as a representative of the Machine Tool Section of the Army-Navy Munitions Board, spoke on the subject of "Man Power," while Wendell E. Whipp, president of the Monarch Machine Tool Co., gave a complete outline of "Women in Production Work," as applied in the Monarch plant. An abstract of Mr. Whipp's address on the employment of women will be found on page 222 of this number of MACHINERY.

George C. Brainard, director of the Tools Division of the War Production Board, dealt with the subject of machine tool requirements in an address entitled "As the War Production Board Sees It." Ralph E. Flanders, president of the Jones & Lamson Machine Co., spoke on the "Renegotiation of Contracts," and F. M. Long, export sales manager of the Gisholt Machine Co., gave an interesting address on "Machine Tool Production in Great Britain."

Present Machine Tool Output

Mr. Brainard, in his address on machine tool production, mentioned that the output of machine tools rose from $90,000,000 in December, 1941, to $137,000,000 in August this year. The latter is at an annual rate of $1,650,000,000. He said that, while this was still short of the goal that the War Production Board had set, it was a very substantial showing under the circumstances. This is generally admitted, since this volume of production is over eight times the best pre-war peace output, and some sixteen times greater than the average output for the industry during the decade preceding the war.

Since December, machine tool plants have been expanded to a value of $77,000,000. At present there is a backlog of unfilled orders on the books of the machine tool industry amounting to $1,100,000,000. With the present rate of production, this would require more than eight months to complete.

Unfortunately, however, this backlog cannot be evenly distributed over the entire industry, since some types of machine tools are required in greater volume than others. One machine tool builder may be able to deliver newly ordered machines four months from now, while in another instance, deliveries may be from twelve to eighteen months ahead. Obviously, the war will not wait for an eighteen months' delivery, and Mr. Brainard stated that ways and means must be found to distribute the load among the various plants of the industry so as to produce the entire machine tool requirements in the shortest possible time. Orders may have to be transferred from one plant to another, if earlier deliveries can be obtained in that way.

Mr. Brainard also discussed the problem of the allocation of materials, pointing out the difficulty created by the necessity of assigning sufficient material to all concerned, because the demands for production materials exceed the available supplies. No one must request earlier deliveries or greater amounts of material than are required to meet his own manufacturing schedules.

With regard to labor, Mr. Brainard said that while it might appear impossible to increase production when so many men are being drafted for the Armed Services, this must, nevertheless, be done, regardless of obstacles. England has demonstrated that it can be done. Women will be employed in the machine tool plants in ever increasing numbers. The reports received with regard to this course are very favorable, the women having proved surprisingly satisfactory.

The following officers were elected: President, John S. Chafee, vice-president of the Brown & Sharpe Mfg. Co., Providence, R. I.; first vice-president, Walter W. Tangeman, vice-president of the Cincinnati Milling Machine Co., Cincinnati, Ohio; second vice-president, Fred H. Chapin, president of the National Acme Co., Cleveland, Ohio; treasurer, David Ayr, president of the Hendey Machine Co., Torrington, Conn. Mr. Tangeman and Mr. Chapin were also elected directors of the Association, as was Joseph L. Trecker, vice-president of the Kearney & Trecker Corporation, Milwaukee, Wis. Tell Berna continues as general manager, and Mrs. Frida F. Selbert as secretary.

Trophies Offered Machine Tool Builders for Increase in Output

John S. Chafee, the newly elected president of the Association, offered to member machine tool companies two trophies to be awarded for the greatest increase in output during the fourth quarter of the year. One trophy is based upon the percentage of increase over the third quarter in number of machine tools shipped, while the other is based upon the percentage increase in dollar value of the shipments made. This distinction has been made in order to give companies of all types a chance to win one or the other. The trophies are intended to inject into the industry's drive for maximum production the further incentive of friendly rivalry.

* * *

Trade Journal Editors Pay Tribute to Donald Nelson

At a recent meeting of engineering, trade, and business paper editors in Washington, a testimonial was presented to Donald Nelson, at a dinner given in his honor. This testimonial was in the form of a scroll inscribed as follows:

"In recognition of the great burden he has carried in leading our country to the attainment of its war production objectives, this testimonial is presented to Donald M. Nelson, who, in the midst of conflict and confusion, shouldered the gigantic task of unifying the nation's resources to out-produce its enemies. Quietly and unassumingly he tackled the job of shifting the balance of power—the job of overtaking the Axis with its seven-year head start—the job of accomplishing this in ten months.

"Historians will record how ably the destiny of our nation was shaped in these crucial months. But we, the editors of the Business and Industrial Press, who enjoy an unusual opportunity to appraise his accomplishments, applaud his efforts today. We are grateful for the privilege of working with him and for his inspiration in building a stronger—a better—America.

"Today, as we enter perhaps the most critical phase of the war effort, when unity and cooperation are more essential than ever, we take this means of expressing our unwavering confidence in him and his organization and hereby reaffirm our fullest support."

A. S. T. E. War Production Conference

CROWDED technical sessions, with standing room only, and a banquet attended by 800, which filled the Springfield Municipal Auditorium, were evidence of the great interest displayed in the semi-annual convention of the American Society of Tool Engineers, held October 16 and 17 in Springfield, Mass.

This comparatively young organization, now one of the three largest engineering societies in the country—numbering some 11,000 tool engineers in fifty-five chapters—centered its War Production Conference program around four vital problems now facing industry: (1) The acute shortage in skilled and semi-skilled workmen. (2) The need for the highest efficiency possible in wartime tooling. (3) The grave material shortages faced on every hand. (4) The vital importance of inspection and gaging.

The opening session, under the chairmanship of Charles C. Gorham, supervisor of training, Greenfield Tap & Die Corporation, Greenfield, Mass., considered the problem of training the hundreds of thousands of new and unskilled women and older men who will be taken into industry. Speaking on "Training the Available Labor Supply," Thomas O. Armstrong, industrial relations manager, Westinghouse Electric & Mfg. Co., Springfield, Mass., stated that a program of instruction to show the workman in the shop how to analyze his own job, so that he can quickly and effectively break in new employes, was proving of great value. Mr. Armstrong pointed out that, particularly in the case of women, fear, nervousness, and lack of confidence must be overcome in the initial stages of the training.

Arnold Thompson, chief tool engineer of the National Steel Car Corporation, Ltd., Malton, Ontario, Canada, discussed "The Training of Women in Industry." S. J. Hoexter, senior specialist in the U. S. Office of Education, Washington, D. C., speaking on "Emergency Training," reported that the Government had sponsored the technical instruction of some 300,000 men and women in various schools throughout the country by means of special courses designed to meet the need for workers with special skills. President Otto W. Winter reported that courses in tool engineering were now part of engineering college curricula and that the A.S.T.E. had been attempting to aid in supplying the great need for adequate instruction material, but little seemed to be available.

The second session, under the chairmanship of Henry J. Richards, chief inspector, supercharger plant, General Electric Co., Everett, Mass., considered problems of inspection and gaging. Carlton G. Nelson, quality engineer, Colt's Patent Fire Arms Mfg. Co., Hartford, Conn., spoke on "Inspection and Inspection Equipment." An interesting system of gage

Highlights of the Tool Engineers' Meeting

Many new and revolutionary material substitutions are on the way. Glass gages are already in the development stage. Plastic punches for drop-hammers have proved successful in aircraft manufacturing plants. A piston-reamer made entirely of a plastic material with inserted high-speed steel cutters has been developed.

New inexperienced employes become useful in the shortest time if they are given a brief intensive course in the work they are to perform. This is more satisfactory than placing them in the shop from the very beginning.

More and more women will be employed in machine shops. In a detailed survey, it was shown that of 623 specific operations performed in a certain plant, 565 could be handled by women. The first thing to do in instructing new workers—especially women—is to overcome the fear, worry, and lack of confidence that hamper them when starting on unfamiliar work.

Tool engineering courses have for the first time become an accepted part of engineering college courses.

Four of the new NE steels—8620, 8630, 8744, and 8949—were said to satisfy 95 per cent of the present-day needs where high alloy steels were formerly used. More recent NE steels (the NE 9000 series) have less chromium, nickel, and molybdenum than the NE 8000 series, and their use may soon become mandatory.

control in effect at the General Electric supercharger plant was described by the chairman. By means of daubs of colored dye, each gage and inspection device is marked with the date of last checking. Without referring to written records, gages that have slipped by the next check-up date are easily spotted.

One of the surprises of the convention was a statement by Colonel H. B. Hambleton, office of Chief of Ordnance, Washington, D. C., that gages made of glass had been developed and might soon be available to aid in the conservation of tool steel. He pointed out that gage production had risen from $4,000,000 in 1940 to an estimated $125,000,000 in 1942, and was expected to reach $170,000,000 in 1943.

Tool conservation was the subject of the afternoon session on October 16, under the chairmanship of Dr. A. B. Kinzel, senior consultant on the Conservation and Substitutions Branch, War Production Board, Washington, D. C. Larry W. Lang, manager of the National Tool Salvage Co., Detroit, Mich., spoke on "Conserving Tool Life through Salvage," and Arthur A. Merry, production engineer, Pratt & Whitney Aircraft Corporation, East Hartford, Conn., spoke on "Tool Conservation."

An interesting Westinghouse exhibit on the use of chromium plating to increase the life of new gages and to build up worn tools, drew considerable attention. New tools ranging from drills and milling cutters to files had shown greatly increased service after chromium plating.

Two sessions on War Tooling were held Saturday morning, October 17. The first was under the chairmanship of R. F. V. Stanton, manager, Sub-Contract Division, Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford. Conn. Elmer A. Clark, vice-president, Budd Wheel Co., Detroit, Mich., and director of the Automotive Council for War Production, stated that by December the automotive industry will be producing at twice its peacetime rate. He said that only by the closest collaboration between automotive companies was this goal being attained. Gordon G. Swebilius, vice-president, High Standard Mfg. Co., New Haven, Conn., spoke on "Emergency War Tooling of Used Machine Tools."

At the other war tooling session, John W. Geddes, chief engineer of H. K. Porter, Inc., Boston, Mass., presided. I. A. Hunt, manager of the Federal Products Corporation, Providence, R. I., spoke on "Sub-Contracting Heterogeneous Work to the Small Shops." William F. Asmus, tool engineer, Consolidated Aircraft Corporation, San Diego, Calif., reported, in his talk on "Plastic Jigs and Fixtures," that, in addition to using plastic jigs and fixtures, plastic punches in drop-hammers, with and without chromium plating, had proved satisfactory for use with Kirksite dies in certain instances.

The last session of the convention centered on the theme "Materials Substitution." Chairman J. B. Savits, methods engineer, Pneumatic Scale Corporation, Ltd., North Quincy, Mass., gave many instances of effective use of substitutes in his plant.

L. S. Bergen, associate director of metallurgy, Crucible Steel Co. of America, New York City, spoke on "Alloy Steels for the National Emergency." Mr. Bergen stated that all consumers, including the Army, Navy, and Air Corps, were being required to use the National Emergency steels to save, primarily, chromium and nickel. He presented many charts to show that hardenability and physical characteristics of these NE steels were not, on the whole, inferior to those of the older S A E steels of similar carbon content and structure. He pointed out that four of the NE steels—8620, 8630, 8744, and 8949—would fill 95 per cent of present-day requirements for alloy steels. He brought out the fact that new substitute steels —designated the 9000 series and containing even less chromium, nickel, and molybdenum, but more silicon and manganese—were already in manufacture and may soon be specified as mandatory substitutes. P. S. Carswell, director of research, and C. H. Whitlock, technical engineer, Monsanto Chemical Co., Springfield, Mass., spoke on "Plastics as Substitutes."

More than 800 participants filled the Springfield Municipal Auditorium floor to capacity for the banquet held at the end of the conference. The speaker of the evening was Thomas H. Beck, president of the Crowell-Collier Publishing Co., who delivered an address entitled "The Greatest Gift is an Open Mind." Mr. Beck was quick to criticize those in responsible positions who persisted at this time in refusing to admit the possibility of meeting today's war problems in new and unprecedented ways. Too many men in high places, he said, have been saying: "It can't be done."

The general chairman of the conference was Frank W. Curtis, chief engineer of the Van Norman Machine Tool Co., Springfield, Mass.

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Special Equipment Built by the Hamilton Gear & Machine Co.

On page 148 of October MACHINERY, was published an article "Special Equipment Increases Production of High-Speed Assembly Press." In this article, it should have been mentioned that the special equipment was devised, built, and assembled in the plant of the Hamilton Gear & Machine Co., Toronto, Canada. Through the arrangement shown, an assembling press was provided with two loading stations for rapid assembly.

MACHINERY'S DATA SHEETS 477 and 478

LOADS AND DEFLECTIONS OF PHOSPHOR-BRONZE ROUND-WIRE HELICAL SPRINGS—3

Upper Figure, Maximum Safe Load P, in Pounds; Lower Figure, Deflection y, in Inches per Coil

Outside Diameter of Spring, Inches	Diameter of Wire, Inches 0.091	0.102	0.114	0.129	0.144	0.162	0.182
5/16	20.7 0.00439	....	....	All values are based on 27,500 lbs. per sq. in. fiber stress. The values given are for severe service. For average and light service, multiply by 1.25 and 1.55, respectively			
3/8	18.4 0.00819	24.7 0.00620	33.2 0.00466				
7/16	16.4 0.0133	22.6 0.0104	30.5 0.00814	42.0 0.00593	....	....	....
1/2	14.8 0.0196	20.3 0.0158	27.8 0.0136	39.3 0.00967	51.5 0.00720	68.5 0.00512	....
5/8	12.2 0.0361	16.8 0.0296	23.2 0.0244	32.8 0.0193	44.6 0.0154	61.5 0.0118	....
3/4	10.2 0.0568	14.3 0.0480	19.8 0.0403	28.3 0.0326	38.6 0.0266	53.5 0.0211	74.0 0.0165
7/8	8.90 0.0833	12.4 0.0706	17.2 0.0596	24.7 0.0492	33.8 0.0409	47.6 0.0333	65.6 0.0267
1	7.86 0.115	11.0 0.0978	15.2 0.0832	21.8 0.0692	30.0 0.0586	42.2 0.0480	58.9 0.0391
1 1/8	7.02 0.151	9.80 0.129	13.7 0.111	19.6 0.0931	27.0 0.0790	38.0 0.0656	53.2 0.0541
1 1/4	6.32 0.192	8.85 0.165	12.4 0.143	17.7 0.120	24.5 0.103	34.5 0.0859	48.6 0.0720
1 3/8	5.76 0.237	8.10 0.205	11.2 0.178	16.2 0.151	22.4 0.130	31.5 0.109	44.4 0.0915
1 1/2	5.28 0.287	7.45 0.251	10.3 0.217	14.8 0.184	20.7 0.160	29.2 0.135	41.0 0.114
1 5/8	4.90 0.344	6.85 0.299	9.56 0.260	13.8 0.223	19.1 0.193	27.0 0.163	38.2 0.140
1 3/4	4.56 0.404	6.40 0.353	8.90 0.307	12.9 0.264	17.8 0.229	25.2 0.195	35.6 0.167
1 7/8	4.26 0.468	5.95 0.405	8.31 0.358	12.0 0.307	16.6 0.267	23.6 0.229	33.3 0.197
2	3.99 0.539	5.60 0.474	7.82 0.413	11.3 0.355	15.7 0.310	22.2 0.266	31.4 0.229
2 1/4	3.56 0.697	5.00 0.610	7.00 0.538	10.1 0.462	13.9 0.403	19.8 0.350	28.1 0.302
2 1/2	3.20 0.870	4.51 0.768	6.28 0.672	9.07 0.584	12.6 0.512	17.8 0.442	25.3 0.384
2 3/4	....	4.10 0.938	5.74 0.828	8.28 0.717	11.5 0.630	16.3 0.547	23.0 0.474
3	....	3.78 1.13	5.26 0.998	7.56 0.870	10.6 0.763	15.0 0.661	21.1 0.574

For maximum safe load and deflection formulas, see Data Sheet No. 475, October, 1942.

MACHINERY'S Data Sheet No. 477, November, 1942

Compiled by J. I. Hommel
Westinghouse Electric & Mfg. Co.

LOADS AND DEFLECTIONS OF PHOSPHOR-BRONZE ROUND-WIRE HELICAL SPRINGS—4

Upper Figure, Maximum Safe Load P, in Pounds; Lower Figure, Deflection y, in Inches per Coil

Outside Diameter of Spring, Inches	Diameter of Wire, Inches 0.204	0.229	0.258	0.284	0.325	0.365	0.410	0.460
1 1/8	64.4 0.0388	....	....	....	The values in these four columns are based on a fiber stress of 21,000 pounds per square inch.			
1 1/4	58.8 0.0517	81.8 0.0422	....	....				
1 3/8	54.1 0.0669	75.4 0.0550	106 0.0444	....	....	....	....	....
1 1/2	49.8 0.0834	69.9 0.0696	98.8 0.0563	129 0.0476	....	....	....	....
1 5/8	46.4 0.103	65.2 0.0860	91.8 0.0705	120 0.0596	156 0.0408	....	....	....
1 3/4	43.4 0.124	60.6 0.104	85.9 0.0859	113 0.0732	146 0.0504	....	....	....
1 7/8	40.6 0.146	56.8 0.123	80.7 0.102	107 0.0883	138 0.0612	192 0.0496	....	....
2	38.3 0.171	53.8 0.145	76.0 0.121	101 0.105	130 0.0728	181 0.0596	250 0.0476	....
2 1/4	34.3 0.226	48.2 0.193	68.2 0.162	90.4 0.141	117 0.100	163 0.0822	229 0.0672	316 0.0540
2 1/2	31.0 0.289	43.6 0.248	61.8 0.210	81.8 0.182	106 0.131	150 0.109	209 0.0897	291 0.0734
2 3/4	28.3 0.360	39.7 0.309	56.6 0.263	74.8 0.230	97.5 0.166	136 0.139	192 0.116	267 0.0960
3	25.9 0.486	36.0 0.377	51.8 0.321	69.1 0.284	90.0 0.206	126 0.173	177 0.145	248 0.121
3 1/2	22.3 0.616	31.4 0.534	45.0 0.461	59.6 0.406	77.8 0.298	110 0.254	154 0.215	216 0.181
4	....	27.6 0.720	39.3 0.620	52.3 0.550	68.4 0.407	96.7 0.349	136 0.297	190 0.252
4 1/2	....	....	35.1 0.807	46.6 0.716	61.0 0.532	86.5 0.453	122 0.394	170 0.335
5	....	....	....	42.2 0.908	55.0 0.674	77.9 0.582	110 0.501	154 0.430
5 1/2	The values in these four columns are based on a fiber stress of 24,000 pounds per square inch.				50.1 0.832	71.0 0.722	100 0.624	141 0.536
6					46.2 1.01	65.0 0.874	92.2 0.760	130 0.656

The values given in this table are for severe service. For average service, multiply these values by 1.25; for light service, multiply by 1.55.

For maximum safe load and deflection formulas, see Data Sheet No. 475, October, 1942.

MACHINERY'S Data Sheet No. 478, November, 1942

Compiled by J. I. Hommel
Westinghouse Electric & Mfg. Co.

Machine Tool Dealers Hold Annual Meeting

THE annual meeting of the Associated Machine Tool Dealers of America was held Wednesday, October 7, at the Hotel Pennsylvania, New York City. The president of the Association, F. B. Scott of the Syracuse Supply Co., Syracuse, N. Y., presided. The opening session was devoted to reports of the various committees. Among these was one entitled "Report from the Washington Front," by A. G. Bryant, chairman of the Committee on Government Relations, and member of the Machine Tool Industry Advisory Committee of the War Production Board.

Dan Harrington, New President of the Associated Machine Tool Dealers of America

At the second session, addresses were made by Brigadier General H. F. Safford, chief of the Production Service Branch of the Office of the Chief of Ordnance, who spoke on "Conservation of Production Machinery and Materials"; by Mason Britton, vice-president of the McGraw Hill Publishing Co.; and by N. P. Lloyd of Lloyd & Arms, Inc., Philadelphia, Pa., who spoke on "The Activities of the Machine Tool Panels."

General Safford referred to, among other things, the important activity now occupying the Industrial Division of the Ordnance Office of redesigning various war material products to use less of scarce materials and to facilitate production by simplifying the manufacturing operations. This work will gradually reduce machining operations and make it possible for the same volume of machine tool equipment in a plant to produce more units of the war material that is so urgently required.

Mr. Britton referred especially to the dealers' and salesmen's work under the present conditions. He emphasized that salesmen can be especially useful if they concentrate on service work —on helping manufacturers to use their machines and tools to the best possible advantage. Sales engineers visit a great number of plants and become familiar with the best practice. They have an unusual opportunity at the present time of passing along to others the knowledge that they have thus acquired.

Mr. Scott, in his address, called attention, among other things, to the desirability of using smaller sizes of electric motors in order to save copper and material in general. He advised that motors be ordered as nearly as possible for the service to be performed. At this time, oversized motors should not be ordered merely on the chance that some time in the future they may be required. At present all ordering should be for immediate requirements, so as to conserve labor and materials. He also urged everyone to give careful thought to their labor requirements since, by necessity, the Selective Service Draft for the Armed Forces is going to take more and more of the available men below the age of forty-five.

The meeting was unusually well attended, and in addition to the large number of dealers represented, a number of machine tool builders were present.

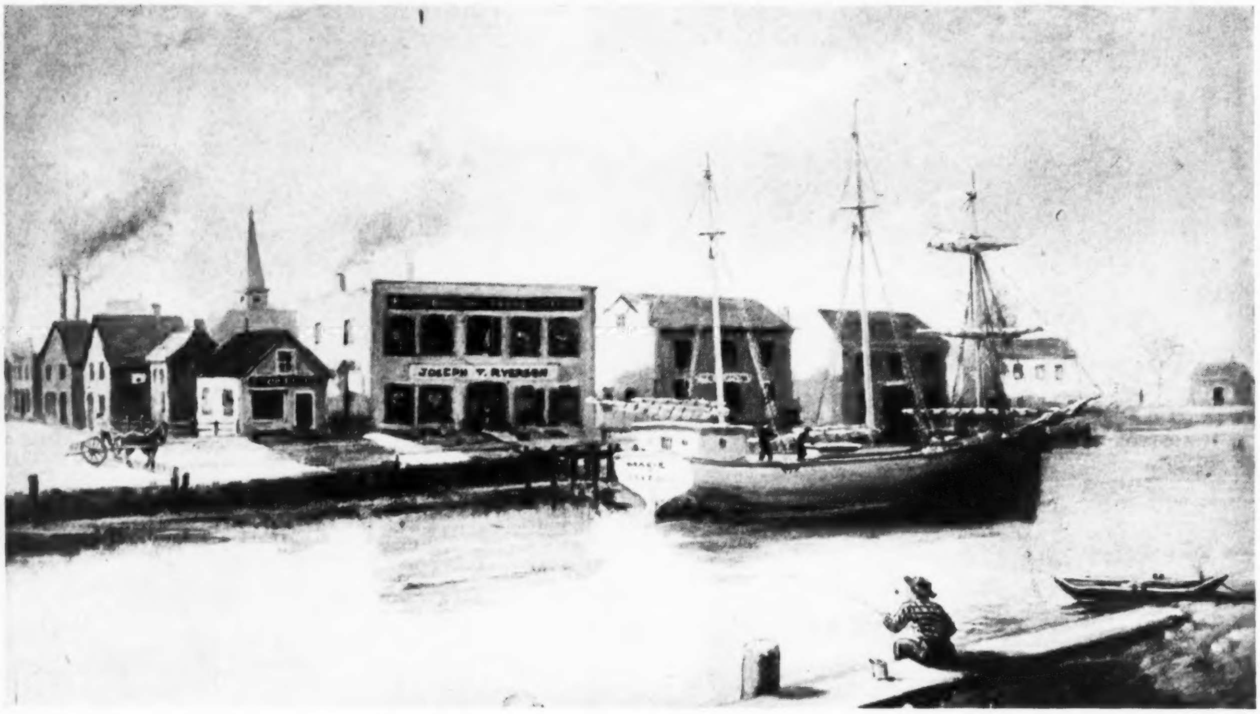
The officers elected were as follows: President, Dan Harrington, general manager, Wilson-Brown Co., New York City; first vice-president, Albert M. Stedfast, Stedfast & Roulston, Inc., Boston, Mass.; second vice-president, A. B. Einig, general manager, Motch & Merryweather Machinery Co., Cleveland, Ohio; secretary-treasurer, George Habicht, Jr., president, Marshall & Huschart Machinery Co., Chicago, Ill.

* * *

Pontiac Rewards Production Suggestions of Employes

Six months ago, the Pontiac Motor Division of the General Motors Corporation instituted a suggestion plan, which, up to a short time ago, had brought in ninety-four production-speeding suggestions. The rewards for these suggestions totaled $5564.50 in war bonds and stamps. The highest award was $434.50, the average being about $60.

Ryerson Business Celebrates



The First Ryerson Store in Chicago Opened in 1842. Since, in Those Days, Most of the Iron Came from Pittsburgh, it was Known as the "Pittsburgh Iron Store"

EXACTLY one hundred years ago—in November, 1842—Joseph T. Ryerson, then a young man of twenty-nine, went west from Pittsburgh and established an "iron store" in a country town with a population of 6000. The town had no railroad, but was located on a river suitable for shipping. Muddy streets, at times almost impassable, prompted young Ryerson to locate his Chicago "iron store" on the banks of the river, handy to shipping. Though the town was small, it was rapidly growing, and seemed ideal for the development of a business suited to serve a growing community with its adjacent trading territory. Since in those days most of the iron came from Pittsburgh, the first Ryerson sign read "Pittsburgh Iron Store."

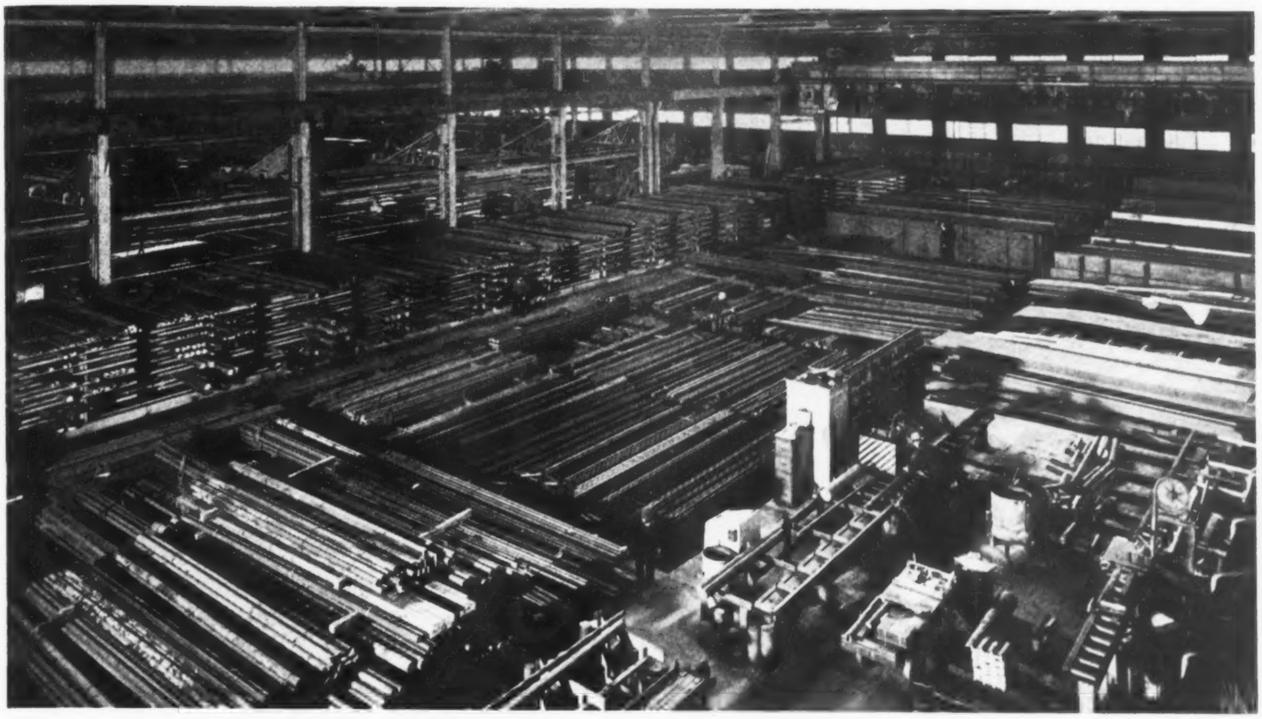
In the century that has followed, this small "iron store" in pre-railroad Chicago became the nucleus of a nation-wide organization now known as Joseph T. Ryerson & Son, Inc., with plants and warehouses in ten large cities—warehouses that measure floor space in acres, spur trackage in miles, and annual shipments in tens of thousands of tons. These warehouses carry stocks of iron and steel of more than 11,000 different kinds, shapes, and sizes. Today, the firm is headed by Edward L. Ryerson, grandson of the founder, as chairman of the board. Mr. Ryerson is also chairman of the Inland Steel Co. with which the Ryerson company is closely affiliated. Everett D. Graff, steel executive of long experience, who has been associated with the Ryerson organization for thirty-five years, is president of the company.

Even in 1842, the name "Ryerson" was well known in the iron business. As far back as 1750, members of the Ryerson family had been active in developing ore deposits in northern New Jersey and making pig iron from the ore. During the Revolutionary War, Ryerson mines and forges furnished some of the iron used in the famous chain which blockaded the Hudson River at West Point.

Young Ryerson did not live exactly in luxury in those early days in Chicago. He slept in a room over his store, and boarded for $2 a week at the Tremont House, an establishment that was also sometimes frequented by a young down-state lawyer by the name of Abraham Lincoln. In later years, Mr. Ryerson said that he "rather enjoyed" fighting difficulties. Apparently, he rather enjoyed work, too, for at first he was his own receiving clerk, shipping clerk, salesman, and bookkeeper.

However, Chicago was growing with a rush and a roar—and so was the Ryerson business.

Its One-Hundredth Anniversary



One of the Present Ryerson Plants and Warehouses. This Plant Covers Five City Blocks. It has Eight Railroad Sidings where Forty-seven Cars can be Unloaded Simultaneously Indoors

Within six months of the opening of the first store, new and larger quarters were rented; and two years after the founding of the business, Mr. Ryerson leased some land and erected a two-story brick warehouse in what is now the Chicago Loop District. Here he added to his stock of nuts and bolts, and bar and sheet iron, a line of hardware. He recognized the advantage of supplying his frontier customers not only with iron, but with the tools for working it. By 1852, when Chicago had grown to a town of more than 30,000 population, the business was again expanded through the purchase of a dock site on what is now Wacker Drive.

The Chicago Fire of 1871 totally destroyed the Ryerson properties, but immediately new stocks were ordered, and the business was carried on in a temporary location while a new store was being built. In 1882, the year before Joseph T. Ryerson died, a new three-story building with increased facilities was erected north of the Chicago River on Milwaukee Avenue. At that time, the small prairie town where Mr. Ryerson started his business had grown to be one of the large cities of America, with a population of half a million people. But more important than the mere growth and population of the city and of the country itself, was the industrial change that had taken place within a span of forty years.

The iron industry of the country had changed to a steel industry, and the continent was spanned by bands of steel. When Mr. Ryerson went to Chicago, the only railroad in what was then generally known as the West, was advertising the slogan "Toledo to Adrian — 33 miles —and return the same day." The name "Bessemer," which was destined to revolutionize the steel industry, had not yet been heard of. In the last few years of Mr. Ryerson's life, steel had made possible the building of the "incredible" Eads Bridge across the Mississippi, and work on the "impossible" Brooklyn Bridge had begun. Yet the steel business was still in its infancy; as it grew, the Ryerson business grew with it.

In 1888, the business was incorporated as Joseph T. Ryerson & Son, Inc., under the leadership of Edward L. Ryerson, a son of the founder. A few years later, the company moved to a tract covering twenty-eight acres at 16th and Rockwell Sts., where it is still located. At the time of the last World War, the stock of steel carried at the Ryerson Chicago plant was greater than the combined warehouse stocks available in any three cities in America. It was then that

the company decided to branch out with warehouses in other cities. In 1914, the W. G. Hagar Iron Co., of St. Louis, was purchased. During the following fifteen years, plants and warehouses were established in Jersey City in 1915; Detroit, 1916; Buffalo, 1919; Cincinnati, 1923; Milwaukee, 1924; Boston, 1926; Cleveland, 1927; and Philadelphia, 1929. Just as Joseph T. Ryerson in his early Chicago days handled hardware to provide his customers with tools for working iron, so today an important department of the Ryerson business distributes a varied lined of metal-working machinery.

Furthermore, constant metallurgical research, both in the Ryerson laboratories and in conjunction with steel mills and manufacturers, brought about the development of Ryerson "Certified Steel"—a plan for quality control, the steel carried in stock being accurately identified, certified as to quality, and accompanied with a statement of physical and chemical properties.

Obviously, at the present time the Ryerson organization furnishes steel for all essential war industries, and practically all of its shipments go directly into the war effort.

War Production Board Sends Requests to Industry in Salvage Drive

IN connection with the effort to collect scrap iron for the steel industry, the War Production Board has sent a letter to tens of thousands of manufacturing plants emphasizing the necessity of removing dormant scrap items such as obsolete machinery, tools, auxiliary equipment, dies, jigs, fixtures, etc., that cannot be employed in the war production effort, or in the future, because they are broken, worn out, impossible of satisfactory repair, dismantled, or in need of unavailable parts. Manufacturers are requested to carry out the following simple program:

1. Instruct the salvage executive of your plant, together with other necessary executive officials, to inspect all areas of your plant to determine what salvageable items falling in the dormant scrap classification can be scrapped because of being of no further use.

2. Each such item should be clearly marked for quick identification and a list made in duplicate, so that the plant management may authorize the disposition of each item. The approximate weight should be indicated opposite every piece of dormant scrap.

3. Please arrange immediately to dispose of at least one-third of the total tonnage within a thirty-day period after receipt of this letter. Another third should be moved within the next thirty-day period, and the final third during the next thirty-day interval—or a total disposition within ninety days.

4. A fieldman, properly certified by the Industrial Salvage Section, Conservation Division, War Production Board, will call on you (a) to help, in doubtful cases, in the prompt identification of dormant scrap items; (b) to assist in facilitating the disposition of dormant scrap; and (c) to obtain a report on approximate dormant scrap tonnages moved within any thirty-day period.

National Metal Exposition in Cleveland

THE twenty-fourth annual National Metal Exposition held in Cleveland, Ohio, October 12 to 16, had an attendance of over 46,500 people from all parts of the United States, Canada, and South America. According to W. H. Eisenman, managing director of the exposition and national secretary of the American Society for Metals which sponsored it, the attendance was the largest in the history of this event.

In conjunction with the exposition, meetings were held by four societies—the American Society for Metals, the Wire Association, the American Welding Society, and the American Institute of Mining and Metallurgy. The total registration at the sessions of these four societies constituted a new high record of 23,285. All the sessions, including the American Society for Metals' War Production meetings, were unusually well attended, with as many as 1800 people present at a single session. It is expected that the Metal Congress and Exposition in 1943 will be held in Chicago.

* * *

The American Gear Manufacturers Association reports that industrial gear sales for September, 1942, the last month for which complete statistics are available, were 44 per cent above September, 1941.

Design and Manufacture of Aircraft Engine Gearing*

Abstract of a Paper by P. W. Brown and Earle V. Farrar of the Wright Aeronautical Corporation Presented before the Semi-Annual Meeting of American Gear Manufacturers Association

MODERN aircraft engines require a large number of gears. These gears must be of the highest precision. The propeller reduction gear for one of the Wright engines is of the planetary type, consisting of a stationary central gear, twenty small pinions carried on the propeller shaft, and a large internal gear surrounding the pinions. The large internal gear is driven at crankshaft speed, and the pinion-carrying frame on the propeller shaft at nine-sixteenths of the engine speed. The twenty pinions on the propeller shaft have fifteen teeth each, of 10.4 diametral pitch, 23-degree pressure angle, and 0.872 inch face width. The internal or driving gear has 135 teeth, and the sun or stationary gear has 105 teeth.

At take-off power, each of the pinions carries a load of 80 H.P., and each tooth operates under a maximum contact pressure of 120,000 pounds per square inch. The tangential load on each tooth is 372 pounds. The torque transmitted to the propeller by the complete gear is 74,800 inch-pounds.

Because no special design features have been provided to equalize the loads on the various pinions, it is necessary to hold the pinion-bearing stud spacing to plus or minus 0.0005 inch, and the pitch of the gears to plus or minus 0.0002 inch. The rims behind the teeth of all the gears must be flexible to further assist the equalizing action, and must be carefully proportioned to provide uniform bearing along the length of the teeth.

Another example of interest is the supercharger impeller driving gear. This gear transmits as much as 170 H.P. to revolve the impeller at a maximum of ten times the engine speed, or 24,000 R.P.M. (400 revolutions per second). There are 24 teeth on the impeller drive pinion. The pitch-line velocity reaches 15,120 feet per minute, which means that 9600 teeth are in action per second. In order to operate successfully under these conditions, tooth forms, tooth spacing, and concentricity about the bearing axis must be extremely accurate. The limits are plus or minus 0.0002 inch for the pitch. The concentricity of the pitch circle with the bearing axis must be accurate within 0.002 inch.

Some Design Considerations

One of the important points that must be considered in the design of gearing for aircraft engines is the fact that, because the gears are light in weight and the supporting structure is light and flexible, the effect of any elastic deflection under running loads must be taken care of. When multiple-pinion planetary systems are used, some method of equalizing the load on the pinions must be employed. In most cases, this can be done by accurate manufacture and by designing the gear rims to be flexible enough to assist in the equalizing action, as already mentioned.

On some gears, the root radius is completely ground, allowing a surface roughness of only 30 micro-inches. The finish on the tooth blank is about 15 micro-inches.

It has been quite well established that involute spur-gear teeth of the type commonly used in aircraft engines can be made to work at a wide range of pitch-line velocities with a pressure at the center of the tooth contact area of 135,000 pounds per square inch. Some gears are operating at an even higher pressure. The range of the diametral pitch commonly used varies from 6 to 12. In this range, it would be impractical to design a gear with a face width of more than 1 inch.

Some years ago, the stub-tooth form was in common use because of its great static strength. However, the trend is definitely toward full-depth teeth, as their greater flexibility appears to be advantageous in the correction of unavoidable deflections under operating conditions and of the slight imperfections that must occur in the machining process. A further advantage of the full-depth tooth is that the larger overlap permits modification of the tooth form without destroying the rolling action.

In connection with high-speed gearing, it is of interest to note that it has frequently been necessary to modify the lubrication of gears

*The statements and opinions expressed are those of the authors of the paper and should not be construed as any opinion of the American Gear Manufacturers Association.

operating at extremely high velocity, in order to prevent the entrance of an unduly large quantity of oil, which, at high speed, apparently jams the teeth, much as a handful of sand would at lower speeds. The result is a breakdown of the tooth surfaces and possible failure by bending.

With very few exceptions, all aircraft engine gears are of the spur or bevel gear type. Helical gears have not found much favor in aircraft engines. Should the ultimate in quiet running gears be demanded, provisions would have to be made for absorbing the thrust which is at present the feature objected to in helical gears. Herringbone gears, the authors said, would require many assembly problems and be difficult to handle because of dimensional changes in the supports, caused by temperature and deflection. Spiral gears have not been used in aircraft engines, because they do not stand up under the high rubbing speeds with the lubricants available.

Some of the Manufacturing Problems in Producing Aircraft Gearing

The nature of aircraft gears makes it necessary to use manufacturing methods that differ from the accepted practice. In the case of automotive gears, freedom from noise is of paramount importance, and therefore, helical gears are in almost universal use. To eliminate noise and simplify manufacture, the body of many automotive gears is a solid, heavy disk. In aircraft engines, noise is not of great importance, because exhaust and propeller noises far exceed gear noises in intensity, and emphasis is placed on performance and reliability, with a minimum of weight. Plain spur gears are, therefore, the accepted type for use in aircraft engines.

Because of the high speed at which these gears generally operate, the element of accuracy of the involute form, the pitch, and the concentricity are of extreme importance. Distortion during heat-treatment has been the greatest manufacturing problem. Aircraft weight restrictions and compact design requirements result in gear blanks of such section and form that the least variation in size, steel, or furnace temperature produces warpage. Many experiments with heat-treating methods and equipment did not make it possible to completely eliminate distortion, and it was found necessary to correct the gear teeth after hardening. The most generally used process is grinding. Approximately 80 per cent of all aircraft engine gears are finish-ground.

Both generating and formed-wheel type grinders are used. The over-all cost compares favorably with that of unground gears, when all operations required to produce similar gears by other methods are considered. The Wright Aeronautical Corporation was among the first producers to employ gear grinding as a high-production method. Gears that are to be finish-ground need not be prepared so accurately as those to be finished by some other method, but it is important that all operations prior to finish-grinding be sufficiently accurate so that substantially uniform stock will be removed in the final operation.

The grinding operation must be performed with care and skill to avoid burning or cracking of the hardened case. This is done by the use of proper coolants, correct wheel speeds, careful selection of the grade of the wheels, elimination of side-wheel grinding of large areas, and control of the carbon content of the case and the hardness. With experienced operators, no excessive rejections due to grinding checks have been observed.

Finishing Operations on Gears

Finish is an important consideration in highly loaded gears. All tooth surfaces must be free from cutter or wheel marks and blend with the adjoining surfaces without a sharp edge. A particular advantage of gear grinding is the possibility of obtaining a fine tooth finish at the root fillet, where the bending stresses are the greatest. This is especially true of pinions where the cutters or hobs produce generating ridges, which might be the source of possible tooth failure.

An important operation in connection with the finishing of many aircraft engine gears is that of "breaking the edges" at the ends of the teeth. The edges must be broken and blended along the entire tooth profile, as well as at the root fillet. This involves considerable bench work, which, in the case of one pinion, averages 5.8 minutes, while the time for cutting and grinding the teeth is only 9.2 minutes. In other words, 36 per cent of the time required to produce the gear teeth is consumed by the hand operation of breaking the edges.

This operation is usually performed with a pencil wheel or a thin disk on a high-speed motor head. For the final finish and blending, the edge is brushed with a Tampico wheel on a polishing jack. A cup type holder is used to prevent any surface but the edge from being brushed.

There are some gears that cannot be ground because of their design and that, therefore, require a double set-up for rough- and finish-machining. The surfaces of important gears of this nature are finished by lapping. Ground gears are lapped slightly to remove the fuzz produced by the grinding wheel. Both helical and internal type lapping machines are used.

Inspection of Aircraft Engine Gears

In order to minimize the possibility of defective gears getting into service, most aircraft engine gears are given what is known as "100 per

cent" inspection. One of the most important parts of this inspection is the Magnaflux check, by means of which the slightest surface cracks are indicated. The aircraft industry was one of the first to use the Magnaflux inspection of gear teeth. Minute flaws in the material and grinding checks revealed by this method caused a number of rejections when it was first adopted; but this, in turn, led to improvements in materials and processes, so that the gears of today are much superior to those formerly produced, all due to the use of the Magnaflux inspection.

The involute form and pitch of gear teeth are inspected at the final finishing operation as a check on the equipment and machine set-up. In many instances, permanent records are kept to determine the shop variations after definite running periods. In the final inspection, the gear teeth are checked for size and surface finish, and are rolled on both adjustable and non-adjustable type fixtures.

A final check of the gears (and, in fact, of all aircraft engine parts) is the so-called "green run," which involves approximately three hours of running of the completed engine from low load to full speed and power. After this run, all parts are inspected for possible flaws before final assembly, final testing, and shipment.

Materials for Aircraft Engine Gears

Nitralloy steel has several advantages for the production of many aircraft engine gears. Today, about 20 per cent of such gears are made from this material. One of the important advantages of Nitralloy is that its use makes possible surface hardening of the teeth of large gears of light section, which it would be utterly impracticable to carburize and quench. The surface hardness does not change after brief service, as frequently happens with a carburized case. The Wright planetary gear systems are generally constructed with a carburized pinion running between a Nitralloy stationary gear and a Nitralloy driving gear. This is because the sun gear and the surrounding gear are usually large and of thin or complicated section.

All gears are made from forgings, with carefully controlled flow lines, in order to secure maximum strength. It has been well established that steel parts are somewhat weaker under repeated loading and impact across the forging flow lines than in the direction of the flow lines, so that gears made of bar stock are not likely to be satisfactory. The forgings are normalized and annealed before machining, and the gear blanks are usually finished by grinding before carburizing. Because of the generally fragile and irregular sections of aircraft engine gears, most of them are quenched in dies.

In conclusion, it was said by the authors that they feel that gear grinding as a high-production process has important advantages in connection with the manufacture of aircraft engine gears, because it makes possible the accurate finishing of the teeth and bearing surfaces of hardened gears which are subject to distortion during the heat-treating process. It produces an excellent finish and facilitates obtaining a well finished full radius at the tooth root.

The Work of the Industry Integration Committees

In order to speed up war equipment manufacture, industry has been segregated according to the ordnance item being made by each company, and an Industry Integration Committee has been set up for practically every ordnance item. Each committee is concerned with only one item, and is composed of representatives from the companies making this kind of equipment.

The committees are voluntary, and are affiliated with the Ordnance Department. Each manufacturer has one representative on the committee, and the head of the Ordnance Department branch concerned with the item manufactured is chairman, while a civilian, selected by the group itself, acts as assistant chairman and general manager of the committee. This man is in active charge of the production of the group. He is assisted by one or more ordnance officers.

The work of the committee consists primarily of collecting, correlating, and analyzing information of two kinds. The first is technical information for obtaining the greatest efficiency in manufacturing methods; the second concerns production statistics necessary to develop high rates of output and conserve materials. Smaller firms and new contractors are supplied with technical and engineering data of which they may be in need.

Through some of these committees, recommendations have been made for interchange of materials, parts, tools, and machines, as well as of information pertaining to manufacturing methods. The interchange of equipment is either on an exchange basis or by direct sale.

It is stated that this cooperative plan has worked particularly well in the manufacture of mechanical time fuses. Maximum production was obtained much earlier than expected and without building two new factories that had been projected. This, in turn, meant a considerable saving in materials, labor, and machines.

Women in Machine Tool Plants

Abstract of an Address by Wendell E. Whipp, President of the Monarch Machine Tool Co., Sidney, Ohio, before the Annual Meeting of the Machine Tool Builders' Association

IN normal times, the machine tool industry has very few women employes on machine production. The present scarcity of men has, however, brought the industry face to face with the necessity of employing women in machine tool factories, just as is now being done in Great Britain and Canada. Women played an important part in the war production during the first World War, and in every country in the world, women are now taking over more and more of the work ordinarily done by men.

At the Monarch plant, women were not employed until it became absolutely necessary because there were no more men available. For many months, however, the management gave thought to the problem and gathered as much information about it as could be obtained, so that, when the time came to bring women into the shop, the idea did not seem quite so revolutionary as it otherwise would have.

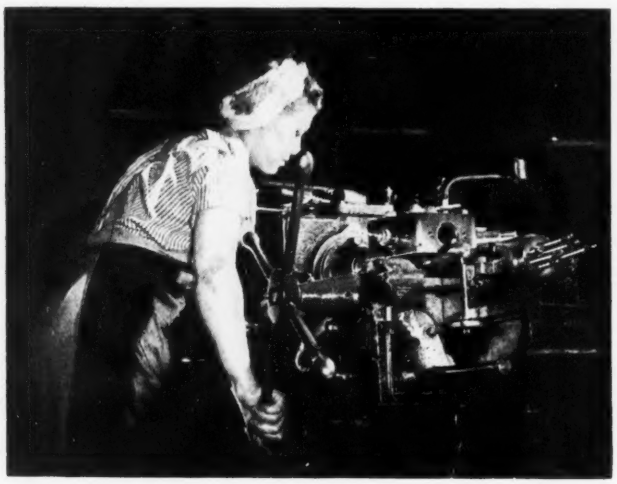
The fact was noted that a very large percentage of women successfully performed all classes of machine and assembly operations in the gun, ammunition, aircraft, and machine tool plants in Great Britain, as well as in Canada. Furthermore, in the great aircraft plants on the Pacific Coast, women constitute at least one-fourth of the working force. Many of these plants expect to employ more women than men in the future. In many of the aircraft plants, women have long since been working beside men without any distinction as to occupation or rate of pay. Hence, in employing women, the machine tool industry does not venture on an uncharted course.

Monarch Plant Started Women on Shop Work Six Months Ago

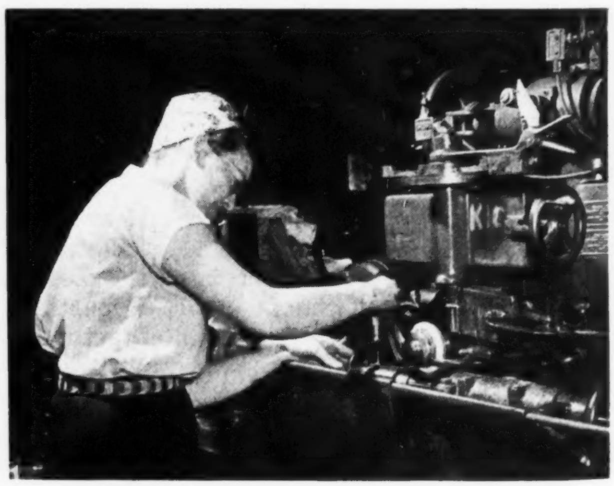
Early in May, the Monarch plant began to employ women in production control and in stock checking. The men replaced by women were put on production jobs elsewhere in the factory to replace men who had entered the Armed Services.

Among the women making application for employment was one who showed unusual promise. She was a mature woman with a background embracing considerable business and legal experience, and it occurred to the management that she might be taken on, you might say, as a laboratory experiment, and that she might later act in the capacity of a supervisor of women. This woman literally tried out one job after another throughout the plant. She went from department to department, working on a wide variety of machines. The purpose was to find out whether a woman could perform these operations after a brief period of training. She was successful in performing almost all of them.

As a result, the management was convinced that women could successfully undertake almost any of the jobs that had been performed by men.



Girl Operating a Turret Lathe in the Monarch Machine Tool Co.'s Plant



Measuring Accurate Work with Micrometers is an Easy Task for Women

This conclusion was reached at the beginning of August. From that date on, women have been added to the factory force as rapidly as they could be absorbed. Today, there are three hundred women working in the shop, almost equally divided between the three shifts. They are also about equally divided between machine operations and assembly work.

Kind of Work on which Women are Employed

Generally speaking, women in the older age brackets are assigned to the assembly division, and the younger women are used in the machine division, because of their capacity to learn the operations rapidly and their dexterity in handling machines. On all three shifts, women now operate all types of machines, with the exception of planers, heavy turret chucking lathes, and other particularly heavy work.

The women have proved themselves well able to handle all types of operations, and the only differentiation between men and women noted thus far has been the degree of physical effort of which they are capable. In the future, when available man power will be still more seriously curtailed, women will be assigned to operation of the heavier classes of machines as well. They will be provided with adequate work-lifting facilities, so as to reduce the amount of physical effort involved.

As new employes, women have shown themselves just as capable of learning how to operate machines as men. In fact, with respect to some types of operations, they have shown themselves superior to men. Here are a few illustrations quoted from Mr. Whipp's paper:

"We have found that women do particularly well in work requiring consistent care and alertness—in jobs where it is necessary to work to close tolerances, involving the use of gages, micrometers, and other checking equipment calling for little physical exertion.

"We have found, too, that women excel in work requiring manual dexterity and speed in repetitive movements. This is especially true in work that permits the operator to set her own tempo, and where she can work in a sitting position. At the same time, we are not sure that whether a woman sits down or stands up at the job makes any great difference. We have found that most of the women in our plant prefer to stand up at a job at which they might just as well be able to sit down on a stool.

The Women Take Their Responsibility Seriously

"A few days ago one of our foremen noticed a woman, working at an assembly bench, standing on a small clean box. He asked her why. She said, 'These new shoes are tight and they hurt my feet, so I took them off. I'm standing on this box to keep my feet clean and not lose any time.' The foreman immediately gave her plenty of nice clean corrugated paper to stand on until she could find a more comfortable pair of shoes. I just pass that incident on to you as evidence of the type of willingness to carry on that motivates so many of these women that we have recently put to work. I think these women realize pretty well that, in working in our plant, they are helping to win the war. They are finding that a woman can help in this war just as well as a man, and they are determined to do their part just as well as a man could do it.

"Now, to go back once more to the point mentioned a moment ago—that women are entirely capable of handling larger and heavier machines if adequate work-handling facilities are provided. Let me give you an illustration:

"The other day one of our superintendents noticed a woman on an assembly job where it

Milling Machine Operation Presents No Especial Difficulties to Women Employes

Using a Portable Drill in Assembly Work—Another Suitable Job for Women

was necessary for her to lift a weight that was close to the 25-pound limit prescribed by Ohio laws. He asked the foreman to change her to a lighter assembly job. The woman said: 'I'll work any place you put me, but I don't want you to get the idea that this job is too heavy for a woman. I'm no panty waist.'

"I cite this instance simply to show that as far as we can see, women are not asking for any discrimination or any special consideration because of their sex. And that, of course, is one of the reasons why we have adopted our wage policy with respect to women."

Women Get Men's Pay for Equal Work

The starting rate for women is five cents less per hour than the starting rate for men; but there is an automatic five-cent increase in the hourly rate at the expiration of the thirty-day probationary period. Furthermore, women who have been through the six weeks' training course in the vocational department of the local schools start at the same wage as men. In the operation of the company's own vestibule training school, women taking the training course go into the plant on the same pay basis as men. The plant is operated on the principle that women are entitled to equal pay with men for equal work.

Some of the Methods Adopted in Employing Women in the Shop

As to the actual mechanics of putting women to work, Mr. Whipp has this to say: "Our new girls are usually put to work in pairs, side by side in the same department. Our supervisor of women introduces the girls to the foreman of the department, and paves the way for their acceptance in that department. The girls feel that they can talk to our supervisor of women on any personal matters that have to do with the feminine side of the picture, but they are definitely under the foreman, and their foreman is the boss.

Tapping in a Radial Drilling Machine Proves Suitable Work

"The question of work costume seems to be one that has bothered many companies who have considered taking women into their employ. In our shop, this worked out very naturally, without any difficulty whatever. The girls adopted, more or less as the standard costume, slacks, a sleeveless shirt, bandana handkerchief, and the machinist's apron. There were variations in colors and styles, and of course each girl likes to get her hair done in whatever way she chooses; but on the whole, feminine costume in our plant conforms to a general type that is practical for the sort of work performed.

"Back in the days of not so long ago, we wondered what would be the effect on morale if we brought women into the shop. I can tell you without any reservations that, as far as our own plant is concerned, I believe the net result has been that of stepping up the morale of the entire organization. I wish you could go out with me into our plant and see the people working there, turning out the lathes that Uncle Sam has to have to win this war. They are all working side by side—handsome girls, strapping young men, older women, men of middle age — all plowing ahead, stepping together to get the job done. There is a sort of camaraderie that develops from this mingling of the sexes in the plant, which we never used to have when we had all men.

"I am convinced that all of us in the machine tool industry must, of necessity, prepare for the employment of women in rather large numbers before this war production emergency is over. And on the basis of our experience, I believe that those of you who still have this transition before you, may be agreeably surprised. I think you will find women far more attentive to their jobs than is the case with most men. The girls take their jobs seriously. When you walk out through the plant, you will see that the girls have their eyes on their work. They are not looking around the shop—they are not grumbling about this or that. They are frequently asking for suggestions as to how they can do their work better, and we are getting some mighty valuable ideas from some of the women in our plant."

Important Points to be Considered when Employing Women on Shop Work

In conclusion, the following points were emphasized by Mr. Whipp:

"Don't get right up to the deadline without making preparations. There are two vital advance steps that must be made. The first has to do with toilets and rest-room facilities. Entirely aside from obvious practical considerations, most states have laws dealing with toilets and rest-

room facilities for women. If you are going to employ women, you must instal in advance the necessary plumbing and the necessary rest rooms. To get these things in time, you must put in your orders in advance, using your priorities to obtain the supplies you need. You can't do this at the last minute. It takes time to get deliveries. If you are going to start hiring women in December, you must get in your orders for toilets and rest-room equipment several weeks before.

"The other point is that you must have a woman in your organization—a reasonably mature and experienced woman, capable of handling women's problems—on the job ahead of time, so that when you start to employ women, they will have a woman supervisor to whom they can turn with their particular problems—a woman supervisor who will understand from personal experience the nature of the work to be done and the questions that will arise from the feminine viewpoint.

"It is necessary, therefore, to obtain a woman of this type far in advance of the actual employment of large numbers of women. She should be brought in early—put through a course of training with respect to the various operations involved—and made to understand that she is to function in the capacity of what you might call the "Dean of Women" for your organization.

"She is not the boss—the foremen and the superintendents are the bosses—but she is the person to whom women can bring any questions dealing with the woman's side of the picture, and she is the person to whom the girls can talk frankly, as one woman to another.

Why Women are Well Adapted for This Work

"It seems to me that the machine tool industry may well step out in the front line in this matter of employing women, because it is largely due to the accomplishments of the machine tool industry that it has been possible for women to be successfully employed in the war production program.

"Owing to machine tool development and design, the machine tool now does the physical work that formerly was done by the operator. The machine tool has within itself the precision and the power needed to get the job done. All that the operator has to do is to have the intelligence and the dexterity to operate the machine. It no longer takes muscle to be a machine tool operator. It takes a certain type of craftsmanship, which the younger generation of Americans have shown that they possess to a very high degree.

"To my mind, it seems very natural that the girls of America should be able to learn this craftsmanship just as well and as rapidly as the boys. Since our industry has largely been responsible for eliminating muscle power as a requisite of factory employment, I think we may as well take our medicine, and recognize that, on the whole, women can operate machine tools and help build them as well as men."

Inspecting the Accuracy of a New Lathe is a Painstaking Task

* * *

Fisher Body Manufactures Additional Line of Machine Tools

In an article in October MACHINERY, page 149, the methods used by the Fisher Body Division of the General Motors Corporation in manufacturing vertical boring mills were described. In the same plant, horizontal boring machines and drilling and tapping machines are now also being manufactured. The horizontal boring machine was designed by Fisher Body engineers for use principally in building anti-aircraft guns and tanks. It is a highly developed machine, weighing 55,000 pounds, and having a 5-inch bar, a 40-inch horizontal traverse and a 60-inch vertical traverse. Each machine is provided with eleven motors. The extent of the electrical equipment will be appreciated when it is mentioned that, for each machine, 4300 feet of wiring is required. The first machine was completed in five months from the time work was started on the design.

In the building of drilling and tapping machines, the company's engineers made use of the available supply of drilling heads. These heads, originally built for use on radial drilling machines, are now being used for horizontal operations. In addition to building these two new types of machines, augmenting the line of planers and vertical boring mills that the company has built for more than a year, work is also progressing on several other projects in the machine tool field.

Substitution of Material in the War Effort*

By E. J. WELLAUER
Supervisor of Research and Metallurgy
The Falk Corporation, Milwaukee, Wis.

Abstract of a Paper Presented before the Twenty-Fifth Semi-Annual Meeting of the American Gear Manufacturers Association

ONLY a few years ago we read about the problems of substitution encountered by foreign metallurgists and felt comfortable in our complacent attitude that we had available an abundance of all materials. Now we also are faced by shortages of many metals and other materials that we need, and substitutions are forced upon us, in order that we may expedite the enormous production required for the war effort, as well as conserve what supplies may be available for purposes for which no satisfactory substitutes have yet been found. In these substitution efforts, the fundamental fact to be recognized is that the service of the substitute material must be equal to the requirements.

One of the chief problems confronting the gear metallurgist and engineer is that of specifying available materials and proper heat-treatments to provide adequate physical properties. It is necessary to study the alloy steels available, and in this connection attention must especially be given to the National Emergency steels—the so-called NE steels. These steels contain low amounts of chromium and nickel, with higher percentages than usual of molybdenum and manganese. A considerable portion, if not all, of the low nickel and chromium contents can be obtained as residuals in the melt. The NE 9400 and NE 9500 series were especially designed to require no additional alloying of chromium, nickel, and molybdenum, since the required quantities can be secured as residuals in carefully selected scrap. Hence, these alloy steels help to conserve the virgin metals, as they can be obtained entirely by the salvaging of chips and other scrap.

Physical Properties of NE Steels

Of primary importance to the design engineer is the tensile strength of gear steels. There is a direct relation between the tensile strength and the Brinell hardness of steels, regardless of alloying content. For sizes under 2 inches, carefully heat-treated, tests show that the tensile strength is equal to 500 times the Brinell hardness number. This formula is correct within 10 per cent.

The yield strength is directly proportionate to the Brinell hardness for small sections fully hardened. The ratio is not affected by the alloying elements. However, in large sizes, a considerable variation exists, dependent on the alloy content in relation to the heat-treatment. For large sizes, the alloys have a higher yield strength for a given hardness.

The same relationship as has been given for bars and forgings holds true for steel castings. The Falk Corporation has always used an intermediate-manganese low-molybdenum cast steel with from 1.25 to 1.50 per cent manganese and 0.20 per cent molybdenum. Over a period of a year or so, the company has placed gears in service having from 1.00 to 1.15 per cent manganese and with molybdenum as low as 0.07 per cent, which amount was secured as a residual in the melt. Except for the lower hardness expected with the reduced amount of molybdenum (which was compensated for in heat-treatment), no difference in the tensile strength to Brinell hardness ratio was noted.

The fatigue or endurance limit has been found by numerous investigators to be directly proportional to the ultimate strength and independent of the alloying metals. Internal stresses, sharp notches, cleanliness of the metal, etc., have a more profound influence than the effect of the alloys. This has been amply substantiated as applicable to gearing through tests reported by several metallurgists.

It is a well-known fact that the modulus of elasticity is constant for steel, regardless of the alloying elements. Hence, elastic deformation—so very important in gears—is not influenced by the lower alloy contents.

Hardness, Wear, and Machinability

As mentioned, the Brinell hardness has a close relation to the tensile strength. Sometimes hardness has also been used as a criterion for the measurement of wear. However, this is not an accurate basis of comparison, since the wear for a given hardness is dependent upon the metallographic constituents and the alloy con-

*The statements and opinions expressed are those of the author and should not be construed as an official expression of opinion of the American Gear Manufacturers Association.

tent. For a given hardness, a material rich in carbide formers (carbon, chromium, manganese, and molybdenum) will show greater wear resistance than a steel low in these elements.

The machinability of metals, as measured by tool life, surface finish, volume of metal removed per minute or hour, speeds, feeds, depth of cut, etc., is highly important in gear manufacture. However, the actual measurement of machinability is largely governed by such factors as the equipment available and the manner in which the equipment is handled by the individual operators. It is expected that the lower alloy steels will have equal, if not superior, machinability qualities, compared with the previously used higher alloy steels.

A study of the machinability of various steels in relation to their hardness has been made. In the hardness range of from 210 to 360 Brinell, usually encountered in heat-treated industrial gears, the effect of the alloying elements is quite negligible, compared to the effect of the variables associated with the machining operation itself.

The greatest aid to machinability, as obtained by sulphur additions and cold-working, is usually found in the low ranges of hardness; but it has also been found that sulphur additions to steels of high hardness are most valuable. There is a definite increase in tool life, and a superior surface finish is obtained.

Distortion in Hardening

The distortion of gears heat-treated after machining is a direct function of the severity of the quench necessary to produce the required hardness. Distortion is also inversely proportional to the alloy content. It therefore cannot be expected that the NE steels, with lower alloy contents, will perform as satisfactorily from the distortion viewpoint, particularly if present heat-treating methods are used. Hence, it is necessary to give more attention in the basic design to means for reducing warpage during quenching when NE steels are used. The sections must be made more uniform, and unsupported rims connected to webs must be made heavier, both at the rim and at the web, in order to prevent a bell-shaped contour after quenching.

The type of heat-treatment has a definite effect on distortion. A direct quench of a case-carburized steel or of a pre-normalized, fully hardened steel produces the least distortion. The fine-grained NE steels are suitable for direct quench, and this method should be used instead of double quenching when minimum distortion is more important than core toughness. When it is not possible to use a direct quench, and when maximum core toughness is required, the reheat quench temperature should be carefully investigated. For example, an increase of the requench temperature by 100 degrees F. over a formerly standardized temperature increased the Izod impact from 28 to 50 foot-pounds for a low alloy steel.

Is a High Core Toughness Necessary in Gears?

An extremely high core toughness is not a primary requisite for gears, as has been thought for a number of years; and except for a few isolated applications, direct quenching is entirely suitable for industrial carburized gears. A fully hardened steel will distort considerably less than a carburized steel. In many instances, this reduced distortion will provide greater load-carrying capacity than the higher hardness of the case-carburized product. This point warrants careful consideration when NE steels are used for gears.

The Falk Corporation has had experience with a manganese-molybdenum steel similar to NE 8020, but having a lower manganese content. Such a steel has given good results, both from the standpoint of reduced distortion and length of service. Core strengths of over 110,000 pounds per square inch are secured. Such core strength is satisfactory, although it is not equal to the 140,000 pounds per square inch obtained with S A E 2315 steel.

From the preceding discussion, it will be apparent that the physical properties required for gearing are little affected by the alloying elements, provided the required hardness and tensile strength can be obtained by proper heat-treatment. It is further apparent that the alloys are acually the tools of the metallurgist, like the lathe and cutting tools of the machinist, and similarly are to be used for providing a finished product meeting the physical property and dimensional requirements. It is therefore necessary, particularly in these times, for the designing engineer or the engineer who specifies materials to be acquainted with the manner in which the alloys affect the heat-treating operations.

Tests have shown that nickel contents above 1 per cent do not contribute greatly to the ability to harden a steel. In fact, nickel can be reduced to 0.80 per cent without great effect. The Falk Corporation has made this change in a chromium-nickel-molybdenum steel to conserve nickel, and has found no difference in the resulting physical properties with identical heat-treatment.

Production Heat-Treatment of NE Alloy Steels

It is expected that the NE alloy steels will require greater care in heat-treatment to produce uniform results. The high alloy steels pre-

viously used were not subject to as great variations as the lower alloy steels. Hence, the high alloy steels could be abused in heat-treatment by quenching within large variations in temperature and yet give substantially uniform results. The use of high alloy steels was sometimes justified economically from the standpoint of uniformity in production results. However, if the new NE steels are carefully handled, they will give satisfactory results.

Quality of Steels Now Obtainable

A problem that concerns the metallurgist is the quality of steels that may result from the pressure being placed upon the steel producers. As yet no change in quality has been noticeable in the smaller sizes, although it has become manifest in large ingots and forgings where increased segregation and refractory inclusions have been noticed. The problem is that of ascertaining just how many and what types of defects can be accepted without interfering with the service performance of the gears.

Cracks, forging bursts, seams, and similar defects cannot be tolerated. Refractory inclusions or sulphide stringers, which do not give definite indications when magnetically tested, may be quite high in numbers without affecting the strength of the steels.

The problem of the effects of non-metallic inclusions has been extensively studied. All the tests show that inclusions do not greatly affect the physical properties. It is, therefore, necessary, in order to promote the war effort, that all so-called "defective material" be carefully rechecked in order to minimize unwarranted rejections, which might absorb considerable time for replacements.

Manganese-sulphide and other non-metallic inclusions produce sharply delineated stringers. Although these would appear somewhat harmful, they are permissible when of small depth. At the plant of the Falk Corporation the inspectors of materials touch these spots with a file, and if they disappear when a few thousandths of an inch of the surface has been filed off, they are considered harmless.

With the present perfected welding technique, there is no reason why many defective forgings of large sizes should not be repaired and salvaged by welding. As the war effort continues, it may be necessary for the gear engineer to accept steels with slight defects that would not ordinarily be deemed suitable. It is desirable that the proper frame of mind be adopted to meet this contingency. It appears that the main problem will be to secure materials that can be adequately heat-treated, if possible by the methods used in the past. If such materials cannot be secured, the heat-treatment procedure must be changed in such a manner that it will suit the new materials.

Substitutions in Bearing Metals

With the present restrictions on the use of tin, manufacturers have been forced to adopt some form of lead-base babbitt for bearings. Lead-base babbitts have been extensively used in the past. A survey of gear manufacturers indicated a very extensive use of lead-base babbitt over a period of twenty years. The usual compositions ranged from 70 to 80 per cent lead, 10 to 15 per cent antimony, 5 to 10 per cent tin, and up to 1 per cent copper.

Such bearings were applied all the way from very small gear drives to large marine and rolling-mill drives. Experience has indicated that the lead-base babbitts are superior when heavy shock or high temperature is encountered. Recent intensive research has resulted in substantial improvements in these alloys. Small proportions of silver and arsenic have been found to be particularly effective in improving the bearing characteristics.

Most commercial gear bearings for gear sizes smaller than 8 inches have been made with bronze backings. Undoubtedly restrictions will soon be issued preventing the use of any copper-base material. Steel-backed bearings have been widely used of late, and have proved satisfactory in all cases. However, the scarcity of steel might make it wise to use a cast-iron backing instead, as cast iron is more easily available and has a higher heat dissipation capacity.

The strength of the bond usually secured with cast iron is approximately 4000 pounds per square inch, compared to from 8000 to 10,000 pounds for a tinned steel backing. To increase the bonding strength between cast iron and lead-base alloys; methods have been developed in which salt baths are used, which eliminate the surface graphite and decarburize the cast iron. The uneven surface caused by the removal of the graphite acts as an additional anchorage. The cast iron is coated with a low surface tension lead-antimony-base alloy, and then babbitted in the usual manner. In this way, bonds equal in strength to those obtained with tinned steel can be secured.

Oil Retainers

Most oil retainers or shaft-sealing devices for commercial gear units have, in the past, been made from aluminum or bronze, because of the anti-scoring properties of these metals. Cast iron provides a suitable substitute. Iron castings of small size will be found to be considerably harder than those received from commercial foundries in the past. This indicates the trend toward high-strength irons at the present time. To provide the maximum anti-scoring properties and machinability, an annealing treatment at a temperature of approximately 1550 degrees F. should be used.

Miscellaneous Substitute Materials

Die-castings previously made of aluminum-base alloys now must be made from a zinc-base alloy, and undoubtedly will eventually have to be made from an antimony-lead alloy. For the purposes for which die-castings are used in gear units, this change will have little effect upon the performance.

Bolts required to be heat-treated in accordance with the American Gear Manufacturers specifications usually have been made from high-carbon steel. Now shortages of high-carbon steel will demand the use of low-carbon cold-rolled stock. Since this material cannot be heat-treated, a lower factor of safety will have to be accepted for the duration of the war.

Except for very unusual applications, the use of alloy steel for shafting is not warranted in commercial gear units. Carbon steel, heat-treated or used "as rolled," depending upon the loading conditions, will prove satisfactory.

Alloy steel springs used in gear units, previously made from chrome-vanadium steel, can be made from carbon-molybdenum, chrome-silicon, or silicon-manganese steels.

The substitution of plastics for various parts of gear-reduction units was at one time considered feasible. However, priority restrictions and price have prevented any substantial trend toward plastics.

The restrictions on tungsten high-speed steels appear to be of serious concern to the gear manufacturer, particularly as applied to the manufacture of hobs and gear-cutters. However, experience has indicated that molybdenum high-speed steel is quite satisfactory, except under very unusual operating conditions.

Necessity for Substitute Materials Emphasized

In conclusion, it may be said that the necessity for substituting materials will continue for the duration. For gear steels, the now available NE low alloy steels will satisfactorily replace, both in production and service, the standard high alloy steels previously used.

There is, however, no assurance that the quantities of alloys in the present NE steels will not be further reduced. Nickel production may not be able to meet the demands of the present NE analysis. Molybdenum may be further restricted, since both domestic and foreign needs can hardly be met by our own domestic supply. Manganese and chromium are in a slightly better position, if carefully used. Vanadium, tin, and copper are, as we know, strictly on the scarce list.

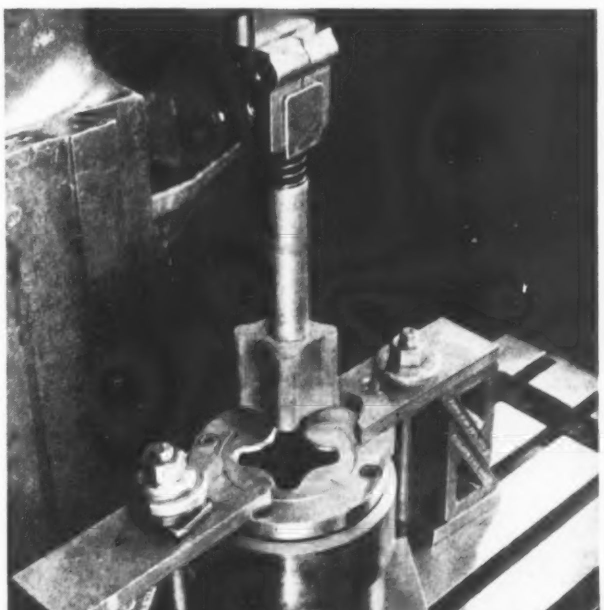
Thus, the substitution of materials has become a definite engineering requirement, and is as much a necessary part of the war effort as the actual production of war materials.

Slotter Set-Up for Lapping Operation

The lapping of intricate high-speed steel compression dies with a universal "Slotmaster" is being performed with considerable saving in time by the use of the set-up here illustrated, which has been developed by the Experimental Tool & Die Co., 12605 Greiner Ave., Detroit, Mich. In addition to the time-saving feature, this method is claimed to eliminate inaccuracies, such as bell-mouth, etc., produced by hand lapping.

The lapping arbor is mounted in the standard clapper-box tool-holder of the "Slotmaster" and is gradually worked into the die opening, aided by pressure from a coil spring. The operation is started by lowering the lapping arbor to the mouth of the die opening, and then setting the down stroke of the slotter so that it will completely compress the spring, which is mounted between a shoulder on the shank of the lapping arbor and the tool-holder.

As the lapping progresses, the spring gradually expands, causing the lapping arbor to work its way into the die opening as a result of the combined stroking motion of the slotter arm and the pressure exerted by the spring. When the spring is completely expanded, the down stroke of the slotter is again set to completely compress the spring. The foregoing procedure is repeated until the full length of the opening in the die has been lapped.



Set-up for Lapping Steel Compression Die in a "Slotmaster"

NEW TRADE LITERATURE

RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To Obtain Copies, Fill in on Form at Bottom of Page 231 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the November Number of MACHINERY

Electric Equipment

GENERAL ELECTRIC CO., Schenectady, N. Y. "Motor Fitness Manual" (Bulletin GED-1017), containing information on how to get the most service out of old and new motors, and data on the selection and application of motors. Circular GEA-3922, descriptive of a new, totally enclosed induction motor for use in magnesium dust, aluminum dust, and other combustible metal dusts. 1

Bearing Lubrication

S K F INDUSTRIES, INC., Philadelphia, Pa. Bulletin entitled "A Guide to Better Bearing Lubrication," containing technical information, of value both to designers and operators, on the lubrication of ball and roller bearings, including oil lubrication, recommended viscosities, circulating systems, spray or mist lubrication, grease lubrication, high-temperature applications, etc. 2

High-Speed Cutting Tools

CRUCIBLE STEEL CO. OF AMERICA, 405 Lexington Ave., New York City. Leaflets TS302 and TS305, giving analyses, recommended service, hardness, and instructions for forging, annealing, hardening, and tempering Rex MM and Rex MMM high-speed steel tools. Folder TS403, containing data on Rexalloy-tipped tools, especially adapted for difficult cutting operations on high-speed production machines. 3

Knurl-Selector Slide-Rule Table

REED SMALL TOOL WORKS, Department M, Worcester, Mass. Knurl-selector slide-rule table, designed to simplify the selection of knurls according to size, pitch, and pattern produced. Included also is a table of average increase in outside diameter of work for representative knurl patterns, pitches, and tooth angles. 4

Heat-Treating Equipment

LEEDS & NORTHRUP CO., 4934 Stenton Ave., Philadelphia, Pa. Catalogue N-33A, on Micromax thermo-couple pyrometers, containing 56 pages of information for wartime pyrometer users on available indicating, recording, and controlling instruments, and the thermo-couples and accessories used with them. 5

Mounted Grinding Wheels

CHICAGO WHEEL & MFG. CO., 1101 W. Monroe St., Chicago, Ill. Bulletin covering the selection and application of mounted grinding wheels, as well as portable tool accessories. The selection guide gives the correct sizes of wheel and wheel specification for grinding different kinds of materials and types of work. 6

Maintenance of Electric Tools

ROTOR TOOL CO., 17325 Euclid Ave., Cleveland, Ohio. Booklet entitled "Keep 'em Working!" stressing the importance of periodic checks of high-cycle electric tools, and giving information on how to maintain maximum efficiency and production from these tools. 7

Drills for Hardened Steel

BLACK DRILL CO., 5005 Euclid Ave., Cleveland, Ohio. Booklet showing various applications of "Hardsteel" drills, and giving data on correct procedure in drilling, countersinking, counterboring, and reaming; use of jigs; coolants; methods of grinding drills, etc. 8

Taps and Screw Threads

GREENFIELD TAP & DIE CORPORATION, Greenfield, Mass. First of a series of educational circulars on taps and tapping, entitled "Tap Talk," containing an introduction to the subject of taps and screw threads, covering the names of the various parts of a tap and threading terms. 9

Air and Hydraulic Cylinders

HANNA ENGINEERING WORKS, 1765 Elston Ave., Chicago, Ill. Circular on Hanna air and hydraulic lic cylinders, containing diagrams showing the various motions obtainable from these cylinders, and the mechanical means for carrying power from the cylinders to accomplish the desired motions. 10

Superfinishing Machines

INTERNATIONAL MACHINE TOOL CORPORATION, FOSTER DIVISION, Elkhart, Ind. Catalogue on Foster general-purpose, 4- by 18-inch and 4- by 36-inch superfinishers. Data is also included on special superfinishing machines and superfinishing attachments. 11

Turret Lathes and Precision Lathes

SOUTH BEND LATHE WORKS, Department M2, South Bend, Ind. Bulletin 1004, illustrating and describing South Bend 1003-Z and 1004-Z bench model turret lathes. Catalogue 13, covering South Bend 13-inch precision lathes. 12

Arc-Welding Machines

TRINDL PRODUCTS, LTD., 2227HL Calumet Ave., Chicago, Ill. Circulars illustrating and describing this company's new Model 125 arc-welder, a low-priced, heavy-duty,

portable bench machine for fast light production and maintenance work. 13

Riveting Machines

HANNA ENGINEERING WORKS, 1765 Elston Ave., Chicago, Ill. Catalogue 232, describing typical examples of the Hanna line of squeeze hydraulic and pneumatic riveters, which are made in seven hundred different styles and sizes to meet all requirements. 14

Electronic Timing Equipment

PHOTOVOLT CORPORATION, 95 Madison Ave., New York City. Circular on the Photovolt electronic timer—an adjustable timing relay with immediate automatic resetting for timing periods from one-twentieth of a second up. 15

Forge Welders

PROGRESSIVE WELDER CO., 3050 E. Outer Drive, Detroit, Mich. Bulletin 301, describing the principle of operation and construction of the "Temp-A-Trol" forge welder, a spot-welding machine that heat-treats the completed weld. 16

Care of Lathes

SOUTH BEND LATHE WORKS, Department M2, South Bend, Ind. Bulletin H-1, containing helpful information on how to keep lathes clean, and pointing out the effect on increased production, reduced scrap, and longer lathe life. 17

Reamer Manual

MCCROSKY TOOL CORPORATION, Meadville, Pa. Manual containing a fund of useful information on reamers, covering design and construction, adjustment and grinding instructions, speeds and feeds, and care of reamers. 18

Planers

CINCINNATI PLANER CO., Cincinnati, Ohio. General catalogue 152, illustrating the entire line of Hypro machine tools, including double-housing and open-side planers, planer type millers, and vertical boring mills. 19

Use of Truing and Dressing Tools

NORTON CO., Worcester, Mass. Booklet entitled "How to Use Truing and Dressing Tools for Better Grinding," containing information on maintaining grinding wheels at a high cutting efficiency. 20

Hyper-Milling

FIRTH-STERLING STEEL CO., McKeesport, Pa. Engineering Bulletin FE-106, containing information on the hyper-milling process of face-milling steel with Firthite-tipped cutters, design of hyper-mills, and performance data. 21

Inclinable Presses

E. W. BLISS CO., 53rd St. and Second Ave., Brooklyn, N. Y. Catalogue on Bliss, Toledo, and Consolidated inclinable presses, with brief data on new features, capacity, speed, and other essential specifications. 22

Carbide Tools

CARBOLOY COMPANY, INC., 11147 E. 8-Mile Rd., Detroit, Mich. New general catalogue covering the company's standard line of carbide tools, including specifications and prices, as well as details on tolerances. 23

Air Motors

SMITH-JOHNSON CORPORATION, 623 E. 12th St., Los Angeles, Calif. Bulletin describing the construction and uses of Senacon fractional-horsepower air motors, applicable to small manually operated machine tools. 24

Heat-Treating Equipment

HEVI-DUTY ELECTRIC CO., Milwaukee, Wis. Bulletin HD-1042, descriptive of the Hevi-Duty gas-cracking unit designed to produce a protective atmosphere for alloy and high-carbon steels during heat-treatment. 25

Hydraulic Surface Grinders

HILL ACME CO., 6400 Breakwater Ave., Cleveland, Ohio. Circular illustrating and describing Hill "Open Side" heavy-duty hydraulic surface grinders, built in horizontal- and vertical-spindle types. 26

To Obtain Copies of New Trade Literature

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Arc-Welding Accessories

GENERAL ELECTRIC CO., Schenectady, N. Y. Bulletin GEA-2704B, covering the complete line of General Electric arc-welding accessories, including goggles, observation shields, head protectors, protective clothing, welding screens, electrode-holders, etc. 27

Bronze Alloying

AMPCO METAL, INC., Milwaukee, Wis. Engineering Data Sheet No. 105, entitled "Experience Essential in Bronze Alloying," describing a case history on the use of Ampco Metal in press bushings. 28

Electric Arc Welding

ELECTRIC ARC, INC., 152 Jelliff Ave., Newark, N. J. Circular entitled "Preheating, Welding, Normalizing, Bending, and Stress Relieving by Electrical Reaction and Induction." 29

Hydraulic Presses

HYDRAULIC PRESS MFG. CO., Mount Gilead, Ohio. Bulletins 4206 and 4207, illustrating and describing, respectively, Fastraverse metal-working presses, and presses for process industries. 30

Electric Furnaces

COOLEY ELECTRIC MFG. CORPORATION, Indianapolis, Ind. Bulletin 50, on small, inexpensive type, electric heat-treating furnaces for industrial and laboratory use. 31

Cylindrical Lapping

NORTON CO., Worcester, Mass. Booklet entitled "Increasing 'Wear Life' by Cylindrical Lapping," describing the use of Norton Hypro-lap lapping machines on cylindrical work, and the correct procedure to follow. 32

Milling Machines

KEMPSMITH MACHINE CO., Milwaukee, Wis. Catalogue illustrating and describing the principal features and attachments of Kempsmith Type G all-geared universal milling machines. 33

Drill Rod

CRUCIBLE STEEL CO. OF AMERICA, 405 Lexington Ave., New York City. Circulars containing data on Victor drill rod and carbon tool-steel drill rod, including size ranges and weights. 34

Production Control

WASSELL ORGANIZATION, Box 390, Westport, Conn. Circular descriptive of the Produc-trol, a control board for keeping a visual record of production, machine loading, purchases, etc. 35

Universal Vises

UNIVERSAL VISE & TOOL CO., Parma, Mich. Bulletin illustrating and describing a universal three-way precision vise suitable for use on milling, drilling, and grinding jobs. 36

Self-Tapping Screws

PARKER-KALON CORPORATION, 202 Varick St., New York City. Booklet 475, covering all types of self-tapping screws and showing typical applications. 37

Manual Starting Switches

ALLEN-BRADLEY CO., 1311 S. First St., Milwaukee, Wis. Bulletin and price sheet covering the Allen-Bradley line of Bulletin 600 manual starting switches. 38

Pneumatic Die Cushions

DAYTON ROGERS MFG. CO., 2835 Twelfth Ave., S., Minneapolis, Minn. Circular giving rules for finding die-cushion size for different sizes of drawn shells. 39

Wet-Dry Belt Surfacing

PORTER-CABLE MACHINE CO., Syracuse, N. Y. Bulletin describing the advantages of the wet-dry belt-surfacing method, and the equipment used. 40

Tap Grinders

HENRY P. BOGGIS & CO., Cleveland, Ohio. Circular descriptive of the Hybco tap grinders for sharpening chamfers, flutes, and spiral points. 41

Care and Adjustment of Motors

CENTURY ELECTRIC CO., 1806 Pine St., St. Louis, Mo. Series of bulletins on the installation, care, and adjustment of motors. 42

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 233-257 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in November, 1942, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

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Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Two-Spindle, Deep-Hole Drilling and Boring Machine

A two-spindle, deep-hole drilling and boring machine has been designed by the W. F. & John Barnes Co., 320 S. Water St., Rockford, Ill., for drilling or boring two parts simultaneously in completely independent cycles. Each piece being bored is driven by independent headstocks, and is supported by separate steadyrests. The tools are fed by independent hydraulically actuated slides.

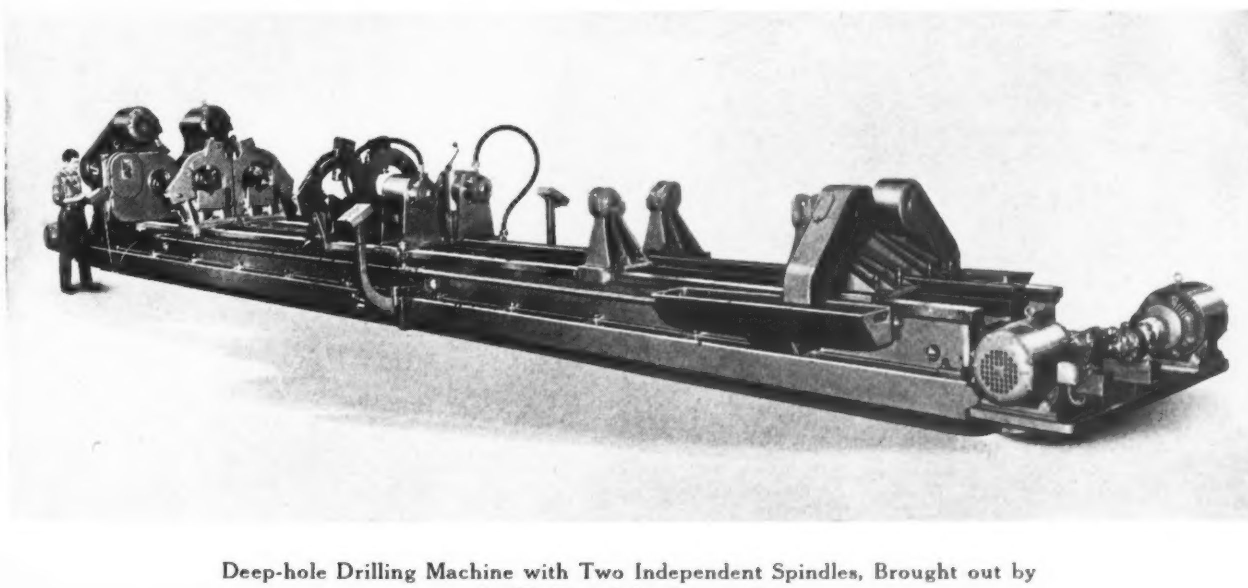
The machine base, with three ways running the full length, is cast in two sections. The head section of the base has T-slots in the center way for clamping the headstocks and steadyrests. Other sliding members are clamped to the two outer ways by gibs bolted to the under side of each member. By loosening the T-slot bolts and the clamp gibs each headstock can be moved to any desired position on the head base.

Four-jaw independent type chucks 15 inches in diameter are normally furnished with the machines, but chucks up to 24 inches in diameter can be used. The steadyrests are of the three-point roller type with adjustment for each roller. Each of the three rollers is carried by a double row of tapered roller bearings. These rollers can be adjusted to take work ranging from 5 to 16 inches in diameter. The top portion of the steadyrests is hinged to facilitate loading and unloading. A vee locater, positioned by means of a hand-crank, is incorporated in the steadyrest to support the work when loading and unloading and to prevent injury to the steadyrest rollers by careless handling.

Two quill type tailstocks, actuated by rack and pinion, are operated by levers at the top of the quill support brackets. Movement of the levers toward a vertical position serves to clamp the quills in place. The tailstocks are clamped to the ways in the same manner as the headstocks and steadyrests.

Whip supports are mounted along accurately scraped ways, and can be positioned midway between the tool-holder and tailstock at the beginning of the work cycle. Thus, springing of the two shanks at the start of the work cycle is prevented by the guide bushings in the whip supports, which remain stationary until the tool-slides have been fed forward to meet the supports. The supports are then carried along the ways until the feed cycle is completed. When the tool-holders are traversed to the starting position, the whip supports are carried to their original positions by latches on each tool-holder, which are controlled by dogs clamped to the center way.

Two motor-driven hydraulic feed and traverse units mounted at the head end of the machine actuate the hydraulic feed cylinders in the base. The machine can be completely controlled from each of the four push-button stations, located



Deep-hole Drilling Machine with Two Independent Spindles, Brought out by the W. F. & John Barnes Co.

To obtain additional information on equipment described on this page, see lower part of page 232.

on each side of the machine, at the side of the head, and at the center of the machine. Each spindle has its own motor-driven, high-pressure coolant pump. Coolant stored in the base is pumped through telescoping pipes at the side of the machine and to the tools through short lengths of flexible hose. Movable chip baskets and chip chutes may be positioned at the head, tailstock or tool-holder, depending upon the operation.

This lathe will handle work 25 inches in diameter by 15 feet 8 inches long. Boring tools 5 inches in diameter can be employed. The hole through the spindle is 4 1/4 inches in diameter. The machine weighs about 83,000 pounds. 51

Foster General-Purpose Superfinishing Machines for Cylindrical Work

A general-purpose superfinishing machine of improved design is being introduced on the market by the Foster Division of the International Machine Tool Corporation, Elkhart, Ind. This machine is built in two sizes, the smaller being adapted for work up to 4 inches in diameter by 18 inches long, while the larger will handle work 4 inches in diameter by 36 inches long.

Both machines are suited for superfinishing operations on a wide range of miscellaneous or regular production work. They are capable of developing an accurate and fine finish of 2 to 5 micro-inches on cylindrical work, such as shafts used in aircraft engines, etc.

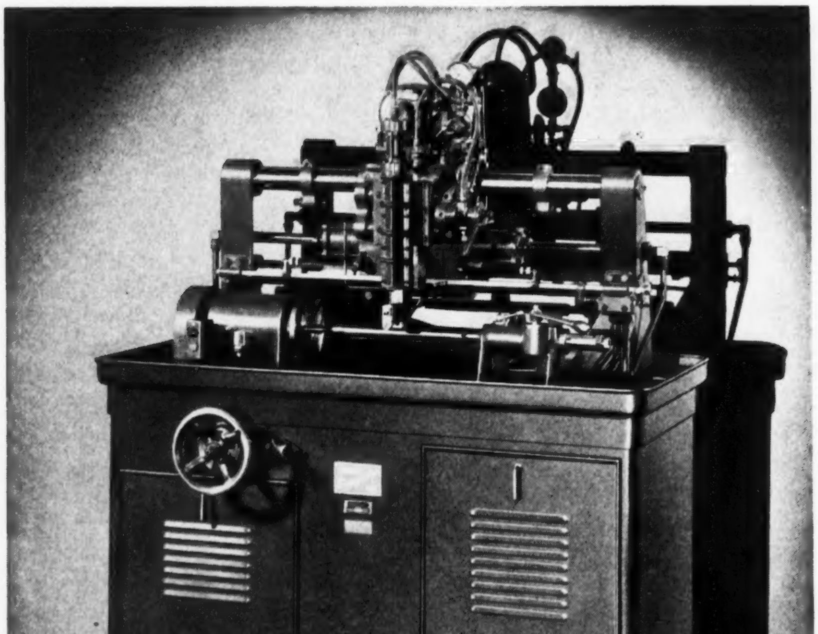
These machines are also adapted for use in small production shops and tool-rooms. By using both coarse and fine abrasive stones, superfinished surfaces can be readily produced on turned work, and at the same time, the work can be brought to the desired dimension.

The oscillating-head carriage is traversed longitudinally by a double-end, hydraulic cylinder bolted to the head carriage. A fixed piston-rod, arranged with a single piston, serves to traverse the cylinder and head in either direction. The traverse rate can be varied from 0 to 30 inches per minute through an aperture control valve. Reversal of the head traverse is accomplished automatically by a directional control valve which is tripped by two adjustable dogs. The length of travel is controlled by setting the two dogs on the square rod which operates the directional valve.

The oscillating head, which is mounted on two rigid guide bars, is arranged with an off-center drive which provides a longitudinal oscillating movement of approximately 3/16 inch. The stone-holding unit is mounted in V-ways, and can be moved toward or away from the work by an oil-operated piston controlled by a directional valve. Pressure on the stone can be varied in accordance with the work requirements by an oil-pressure regulator. A gage provides means for checking the pressure on the stone at any time. The oscillating superfinishing head has a V-belt drive with a self-adjusting sheave wheel, which permits an unlimited number of speed changes ranging from 306 to 638 R.P.M. and correspondingly unlimited variation of the rate of oscillation for the superfinishing head.

A line of four portable superfinishing attachments for cylindrical work has also been developed by this company for use on the cross-slides of engine and turret lathes. These attachments are capable of developing an accurate and fine surface finish (2 to 5 micro-inches, as measured with a profilometer) on a wide range of miscellaneous or production work. The only other equipment necessary for performing superfinishing operations with these attachments is the stone lubricant supply unit, which consists of a small pump, reservoir, and the necessary piping.

The attachments are available in four sizes. The smallest, or No. 0 size, is applicable to superfinishing small-diameter work, such as plug gages and other light production work up to 3/4 inch in diameter. The No. 1 size is designed for superfinishing operations on work from 3/4 inch up to 3 inches in diameter. The No. 2 size is recommended for superfinishing operations on work from 3 to 7 inches in diameter, while the No. 3 size is suitable for work over 7 inches in diameter. The latter, however, can be used on a wider range of tool-room and production work. 52



Improved Superfinishing Machine for Cylindrical Work Built by the Foster Division of the International Machine Tool Corporation

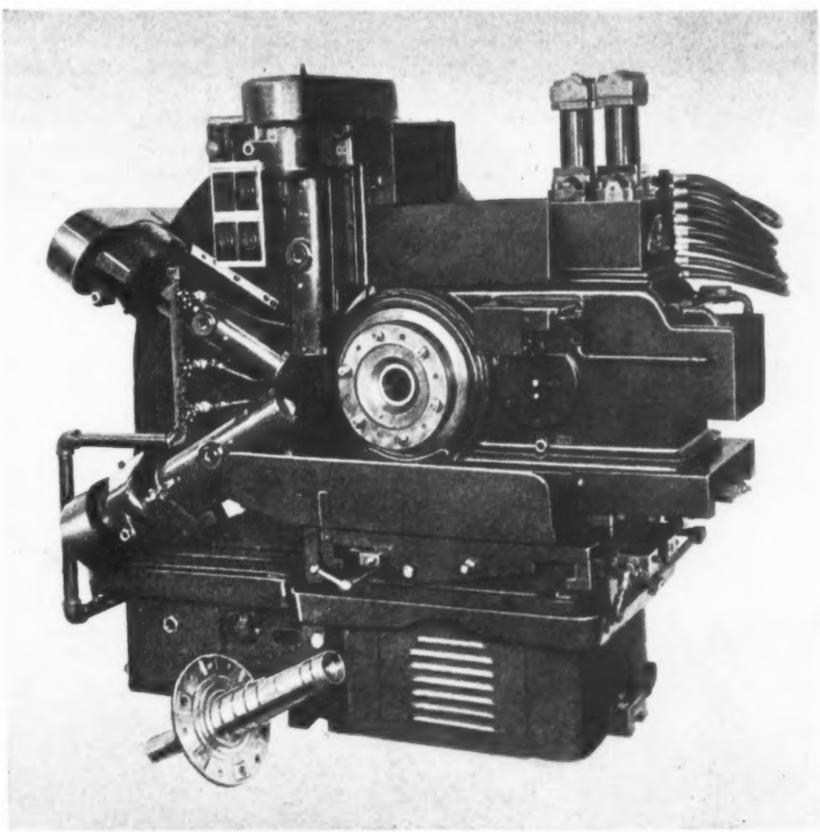
To obtain additional information on equipment described on this page, see lower part of page 232.

Snyder Three-Spindle Rotary Milling Machine

A three-spindle rotary milling machine designed for milling an under-cut in the circular shoulder section of a turned propeller shaft hub to produce six elevated rest pads has been brought out by the Snyder Tool & Engineering Co., 3400 E. Lafayette Ave., Detroit, Mich. The entire operation required to produce the six pads, which can be seen on the hub shown at the front of the machine in the illustration, is fully automatic, except for the movement of a lever between the first and second cycles, the purpose of which will be described in one of the following paragraphs.

After the work is loaded and clamped in place hydraulically, the first cycle starts, the entire fixture assembly and work being moved automatically by hydraulic power along the main slide into the milling position. Next a transverse sub-slide, also hydraulically operated, automatically brings the work into contact with the tools and feeds it forward until the required cutting depth is reached. The piece is then automatically rotated through the specified cutting arc. The machine is equipped with three milling spindles. The tools have taper shanks, and because of their small size are supported by an outboard bearing designed to give them the necessary rigidity.

On completion of the first three cuts, the fixture automatically retracts and rotates the work 180 degrees, after which three more cuts are taken to complete the roughing operation. When the six roughing cuts have thus been completed, the fixture again retracts and the entire fixture assembly moves along the main slide, permitting the operator to inspect the cutters and finish. A small lever is then operated to start the machine through an identical second cycle, in which the finishing cut is made. This finish cut blends with the adjacent surfaces to complete the machining operations on the rest pads. Indexing is automatic, and the rotation of the fixture during the milling cycle is accomplished by heavy-duty hydraulic cylinders, which provide an adjustable feeding rate for the milling operation. 54



Three-spindle Rotary Milling Machine Built by the Snyder Tool & Engineering Co.

Denison Multi-purpose Press

Multi-Purpose Press

A multi-purpose open-side press designed for widely varying operations in the fields of assembling, pressing, and straightening has been added to the HydrOILic line of presses built by the Denison Engineering Co., 1152 Dublin Road, Columbus, Ohio. This press—the Model DLOS2-100—is of 100-ton capacity, and is adapted for either small-lot or production-line work. The streamline design of this press serves to eliminate sharp corners and projections and thus promote safety of operation, as well as improving the appearance.

The frame is of welded steel construction, and the cylinder assembly is of cast steel. The ram is of ground and polished steel fitted with a guide head operating in the ram guides on the inner sides of the press. This unit is available with either a guided platen or a threaded ram. The maximum stroke of the ram is 18 inches, the maximum throat opening 18 inches, and the vertical opening 36 inches. A working pressure up to 2000 pounds per square inch is available.

The press is of compact design, being only 64 inches wide at the base, 40 inches deep, and 11 feet 6 inches high. Dual-control hand tie-up can be furnished to keep the operator's hands out of danger. Either manual or electrical control is available. A separate control provides for an infinitely variable adjustment of the tonnage exerted by the press ram from approximately 10 tons to full capacity.... 53

To obtain additional information on equipment described on this page, see lower part of page 232.

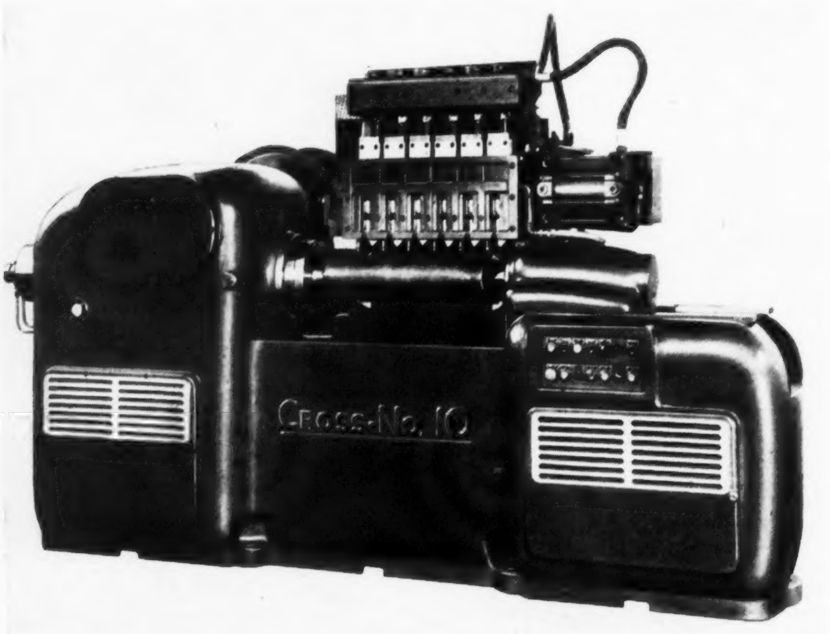


Fig. 1. Cross Automatic Shell-turning Lathe

Cross Shell-Turning Lathe with Electric Push-Button Control

Approved for Publication by the War Department

The Cross Gear & Machine Co., Detroit, Mich., has developed a shell-turning lathe designed for fully automatic operation, and equipped with complete electric push-button control. These features make it possible for unskilled women operators to maintain large-volume production without fatigue. All handles and levers have been eliminated on this machine, the tailstock rapid traverse, spindle clutch, clamps, and automatic operating cycle mechanism all being push-button controlled and interlocked for safety. This equipment enables one operator to attend several machines.

A driving capacity of 100 H.P. and rigid tool support, with hydraulic tool feed and smooth spindle rotation, are features incorporated in this lathe to insure obtaining the full advantage of multiple carbide tooling. The overhead carriage provides the tools with rigid support close to the cutting edge, and allows chips to fall clear of the work. All tools cut simultaneously and without vibration while finishing rough shell forgings to the required form in one operation.

The machine is equipped with an automatic lubrication system which requires no attention from the operator. This system supplies fresh metered oil to every moving part.

The work-holding capacity between centers and the swing can be arranged to meet requirements. Spindle speeds range from 110 to 450 R.P.M. Changes in spindle speed are obtained by means of pick-off gears. The machine is equipped with a No. 11 American standard lathe spindle nose. The hydraulic feed and rapid traverse system is of the manifold design, which eliminates piping.

Three dials are provided for independent precision adjustment of the turning-tool and facing-tool feeds. The multiple-disk clutch enclosed in the headstock is hydraulically operated, and is push-button controlled. The main driving motor, capable of delivering up to 100 H.P. at 1200 R.P.M., is of the general-purpose, open, horizontal ball-bearing type. The floor space required is 135 by 85 inches, and the weight, 23,000 pounds..........55

Multiple-Spindle Milling Head for Machining Staking Notches in Shell Noses

Approved for Publication by the War Department

A multiple-spindle head for simultaneously milling a number of staking notches in shell noses has been placed on the market by the

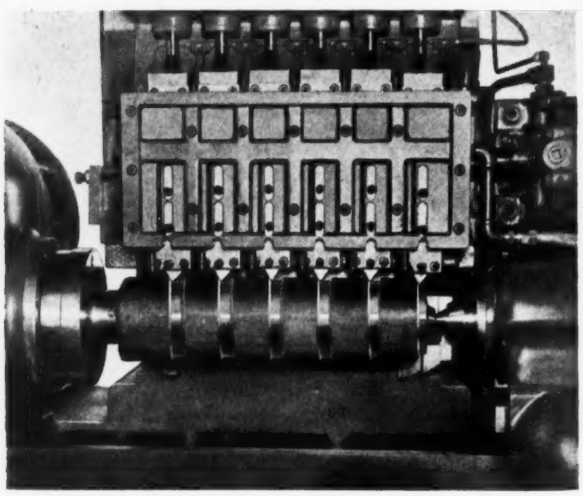


Fig. 2. Close-up View of Work and Tools on Cross Shell-turning Lathe

Kent-Owens Multiple-spindle Milling Head for Machining Staking Notches in Shell Noses

To obtain additional information on equipment described on this page, see lower part of page 232.

Kent-Owens Machine Co., Toledo, Ohio. The illustration shows a five-spindle head which mills all five staking notches in a typical shell at the same time, thus reducing the actual machining and handling time.

The fixture shown is so designed that the shells are rolled onto it from an adjacent conveyor, completely notched, and then rolled back on the conveyor. This unit can be adapted for use on either a Kent-Owens No. 1-8 machine with hydraulic feed to the table or on a No. 1-M machine with hand feed to the table.......56

Gorton Electric Arc Etching Machine

The George Gorton Machine Co., 1316 Racine St., Racine, Wis., has developed an improved electric arc etching process for the permanent identification of parts, tools, etc., which is known as Gorton "Spit-Fire" electric etching. With this new process, the etching is done by a tiny tungsten wire electrode, which is oscillated vertically at the rate of 120 times per second by a magnetic motor. Each time the electrode touches and leaves the metal being etched a high amperage electric circuit is made and broken, creating an extremely hot arc. As the electrode is moved by the pantograph over the work, a steady succession of overlapping tiny craters is produced which form the etched design.

The depth of the etching is controlled by the amount of current, and the width is determined by the diameter of the electrode employed. The moving, intermittent electric arc removes the metal by decomposition, leaving a clear, legible mark or black groove.

The new model A-E all-purpose production etching machine, designed for the application of the "Spit-Fire" process, will etch names, numbers, or other notations deeply on hardened, as well as soft, metals. Either light or deep etching is obtained by simply turning an adjusting dial. The etching can be accomplished quickly and without raising a burr. This machine is capable of marking the hardest steels, as well as the most delicate parts, such as 0.0015-inch flat feeler gage stock. It can be used to perform etching operations in previously inaccessible places, such as inside a cylinder or cavity or around both sides of a V-block.

This etcher is adapted to marking an almost endless variety of work, such as large and small gears, connecting-rods, hardened pins, bushings, collets, etc. The characters engraved or etched can be varied in height from 1/32 inch to much larger sizes.

The model A-E machine is a simple combination of etching head and pantograph machine, developed for those who desire only the essential equipment required for etching. However, this machine is so designed that it can be converted to handle standard engraving jobs, in addition to etching. It is furnished with a choice of either 3 to 1 or 6 to 1 fixed-ratio pantograph. The new electric arc etcher unit can be obtained separately for use with pantograph machines now installed.......57

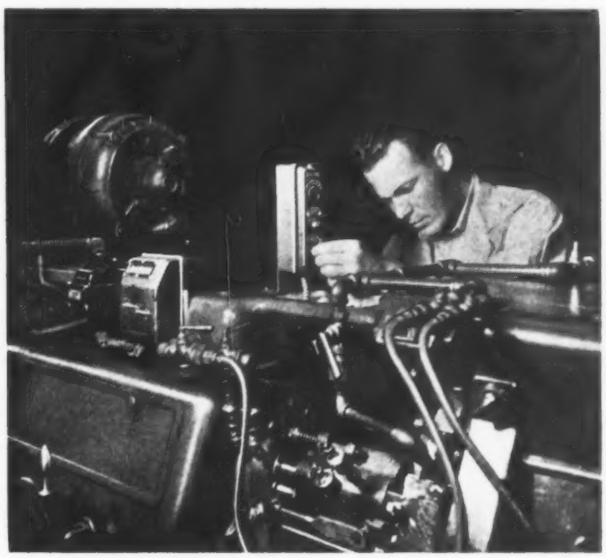
"Snap-Lock" Control-Station Switch for Machine Tools

The Electrical Manufacturing Division of the National Acme Co., 170 E. 131st St., Cleveland, Ohio, has brought out a new line of heavy-duty "Snap-Lock" control-station switches designed specifically for machine tool use. This switch has been adopted as standard built-in equipment on Acme-Gridley automatics, and is now being placed on the market for use on machine tools of other types.

A feature of this switch is the positive snap action obtained, regardless of how slow or fast the push-button is operated. With this snap-lock design, it is impossible for the switch to be left in a partly open or closed position. The clean, quick, make-and-break action reduces arcing to a minimum.

These Snap-Lock control-station switches are readily adaptable to multiple application. Single Snap-

Gorton Etching Machine Designed for Marking Metal Tools and Parts



"Snap-Lock" Control-station Switch Applied to a Machine Tool

To obtain additional information on equipment described on this page, see lower part of page 232.

Lock units can be arranged in combinations to produce control-station assemblies that will handle as wide a variety of functions as required. These assemblies can be of either the flush or surface type. They are obtainable with the following standard markings: Start, Stop, For. and Rev. Other markings, such as Slow, Fast, Jog, Run, Up-Down, etc., can also be supplied.

Entire separate enclosures are provided for mechanical and electrical units, so that there is no chance of electric shock to the operator from a flash-back. 58

Hammond Cylindrical Polishing Machine

A cylindrical finishing machine having a wide variety of applications is being built by Hammond Machinery Builders, Inc., 1619 Douglas Ave., Kalamazoo, Mich. The illustration shows one of many ways in which this machine can be arranged, using a special polishing wheel and an Auto-Doper. It can also be arranged with a backstand idler pulley and segment-face contact wheel, permitting the use of surface-coated abrasive belts which run over the face of the wheel and to the backstand for polishing and finishing parts of many materials and shapes.

This machine is being used in production lines on such parts as universal joints, condenser tubing, steel tubing, etc. It will handle parts having an outside diameter ranging from 1/4 inch to 9 inches. A quick-release lever enables the operator to control the work being fed through the machine by disengaging the work from the face of the wheel. The work-support is adjustable to the wheel by a quick simple means to accommodate work of different diameters. 59

Semi-Automatic Knurling Machine

Approved for Publication by the War Department

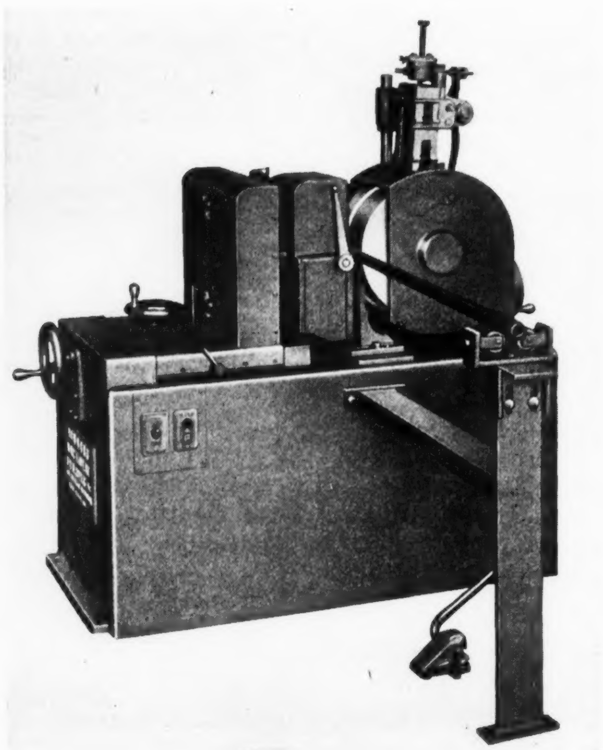
Wm. A. Force & Co., Inc., Brooklyn, N. Y., has recently brought out a semi-automatic knurling machine designed to operate at a production rate of 1000 pieces or more per hour. The work is fed by hand to the machine, operation of the foot-treadle bringing the piece to the knurling roll and then ejecting it upon retraction.

The machine illustrated is equipped with tools for knurling 20-millimeter shells. Similar units can be assembled for knurling other cylindrical pieces ranging in diameter from 1/4 inch to 3 inches. It is claimed that much of the knurling work formerly done on lathes can now be handled more rapidly and economically on these knurling machines. 60

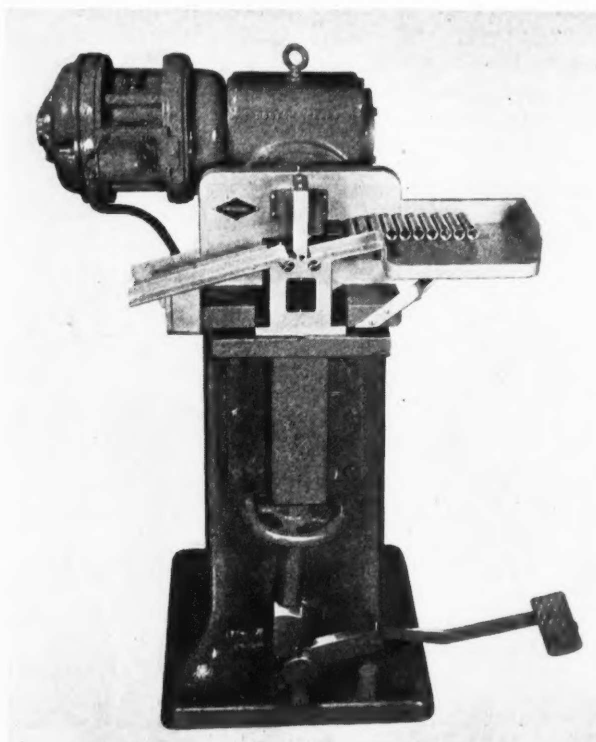
Actuator Mechanism for Precision Snap-Action Switch

A micro-switch actuator, designated Type T, originally brought out by the Micro Switch Corporation, Freeport, Ill., as a throttle warning switch for aircraft, is now finding many other applications. The metal bracket takes any Type Z micro switch, and provides complete mechanical protection.

The operating lever provides an over-travel of 1/8 inch beyond the point at which the snap switch operates. The lever at the operating end is 11/16 inch wide, and is so shaped that it will slide easily over an operating cam or dog. The weight of the actuator without the switch is 2 ounces. The assembly can be mounted singly or in groups or gangs. 61



Hammond Cylindrical Polishing Machine



Semi-automatic Shell-knurling Machine

To obtain additional information on equipment described on this page, see lower part of page 232.

Gear-Shaving Machine for Finishing Small Precision Gears

The National Broach & Machine Co., 5600 St. Jean St., Detroit, Mich., has just brought out a small size "Red Ring" gear-shaving machine, designated the GCL-3, for finishing small precision gears ranging from 1/4 inch to 4 inches pitch diameter. This machine is especially adapted for finishing gears that are required to be very accurate with respect to pitch diameter, tooth spacing, and tooth profile. It is designed to produce instrument gears that are concentric within close limits of accuracy and that will have the least possible amount of backlash when assembled into gear trains for navigation instruments and a great variety of equipment requiring gears of the highest precision. Gears with diametral pitches of from 20 to 48, and even finer, can be handled successfully. The time required for the finishing operation performed on this gear-shaving machine ranges from eight to forty-eight minutes.

Although this is essentially a bench type machine, it is usually furnished with a base, which contains an ample coolant system and an electrical control panel. It can also be supplied without the base, in which case it is necessary to provide a separate coolant system and electrical control panel. A battery of these small machines can be mounted on a long bench served by one central coolant system.

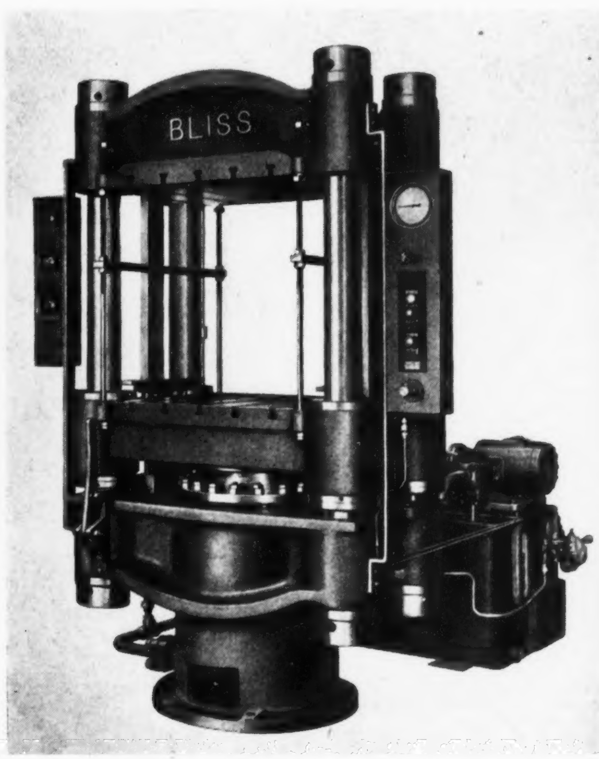
Like other Red Ring gear-shaving machines, it employs the principle of rotary crossed-axes shaving, using a gashed helical cutter, which drives the work-gear as it is being cut. The cutter of this machine rotates only in one direction. The functional parts of the machine, in addition to the cutter-spindle drive, consist of two slides, both operated automatically. The vertical slide, on which is mounted the cutter-head, is advanced and retracted to properly size and finish the work and to return to the loading position.

The horizontal slide, carrying the work-centers, reciprocates the work parallel with its axis across the face of the cutter. The operation of the two slides is so synchronized that in one cycle of the cutter-head slide, the work-slide will make four, six, or eight strokes, as desired, depending upon the amount of metal to be removed. Automatic pressure lubrication is provided for both slides by a pump unit in the column. The machine stops automatically at the end of a cycle. The time for one complete machine cycle ranges from eight to forty-eight seconds. The weight of the bench type machine, with motor, is 900 pounds, while the weight of the base-equipped machine, with pump, motor, etc., is 1650 pounds. 62

Bliss Molding Press

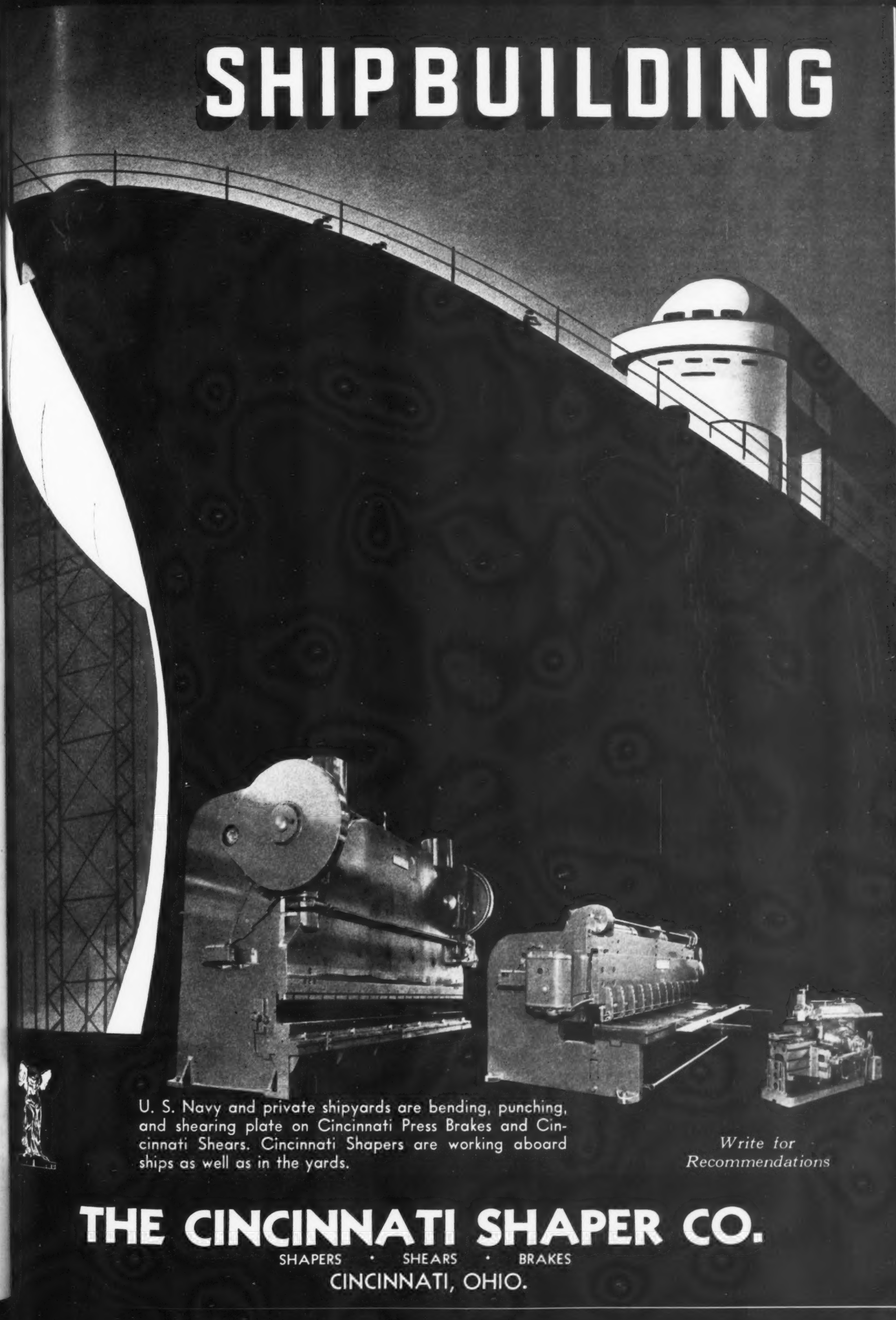
A 250-ton hydraulic press of the semi-automatic hot-molding type, with a completely electrically timed cycle, was recently built by the E. W. Bliss Co., 53rd St. and Second Ave., Brooklyn, N. Y. The automatically timed cycle of this press permits independent adjustment of lengths of preliminary cure, gassing period, and final curing period. A variation of this control affords independent timing of a chilling period, if required, and an independent adjustment of timing for flushing the mold passages at the completion of the cycle. The ability to change from the quick-advance speed to the pressing speed before contact insures entrance into the mold at a slow gentle speed, and

"Red Ring" Gear-shaving Machine



Bliss Semi-automatic Hot-molding Press

To obtain additional information on equipment described on this page, see lower part of page 232.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is particularly advantageous when working with fine molding powders.

A patented method of guiding the platens allows expansion of these members, but maintains accurate guiding of the platen on the rods of the press by means of bronze bushings made with close clearances. Pressure is adjustable over at least a 10 to 1 range, while the automatic cycle may be stopped at any point by an emergency button.

There is no mechanical connection between the press and the pumping unit. Thus, the pumping unit can be placed some distance from the press or immediately behind it and covered by a shield which can be used as a shelf for inspection or other purposes. 63

Heavy-Duty Double-End Facing and Centering Machine

A hydraulically operated and electrically controlled heavy-duty double-end facing and centering machine has been developed by the Snyder Tool & Engineering Co., 3400 E. Lafayette Ave., Detroit, Mich., and is being built in four sizes to take work in lengths ranging from 12 to 20, 20 to 28, 28 to 36, and 36 to 44 inches. This machine consists of two units, each equipped for milling and centering.

The milling spindle is provided with a No. 50 National Machine Tool Builders' Standard taper. It is worm-wheel driven, and is mounted on Timken roller bearings. The centering spindle is ball-bearing mounted and is of quill construction, the quill being provided with hydraulic feed. All moving parts in the unit are lubricated by an oil-pump from a built-in reservoir. Milling cutters from 3 to 8 inches in diameter and center drills from 5/16 to 3/4 inch can be used.

The work cycle of the machine is as follows: After locating and clamping the work in the fixture, the cycle starting button is pressed, causing the fixture and slide to move in rapid traverse away from the operator and thus feed the work between the two milling cutters. When the work is faced to length, the slide returns to the original loading position opposite the centering drills. The centering tools are then fed into the work, and the return of these tools to the starting position completes the cycle of operations.

The welded steel base of the machine encloses the hydraulic equipment, piping, etc., and adjustable trip-dogs, which are set up at the beginning of the job for the respective work lengths. The coolant is contained in an auxiliary tank at the rear of the machine. The cover of this tank serves as a removable chip tray. 64

Snyder Double-end Facing and Centering Machine

Fig. 1. Light-duty Tapping Machine Built by Detroit Tap & Tool Co.

Detroit Tapping Machines

The Detroit Tap & Tool Co., 8432 Butler St., Detroit, Mich., has brought out a new line of special high-production precision tapping machines. These machines, although of special design, can be adapted for a variety of operations. They can be provided with either single or multiple tapping heads or they can be used for oil-grooving or long-lead tapping.

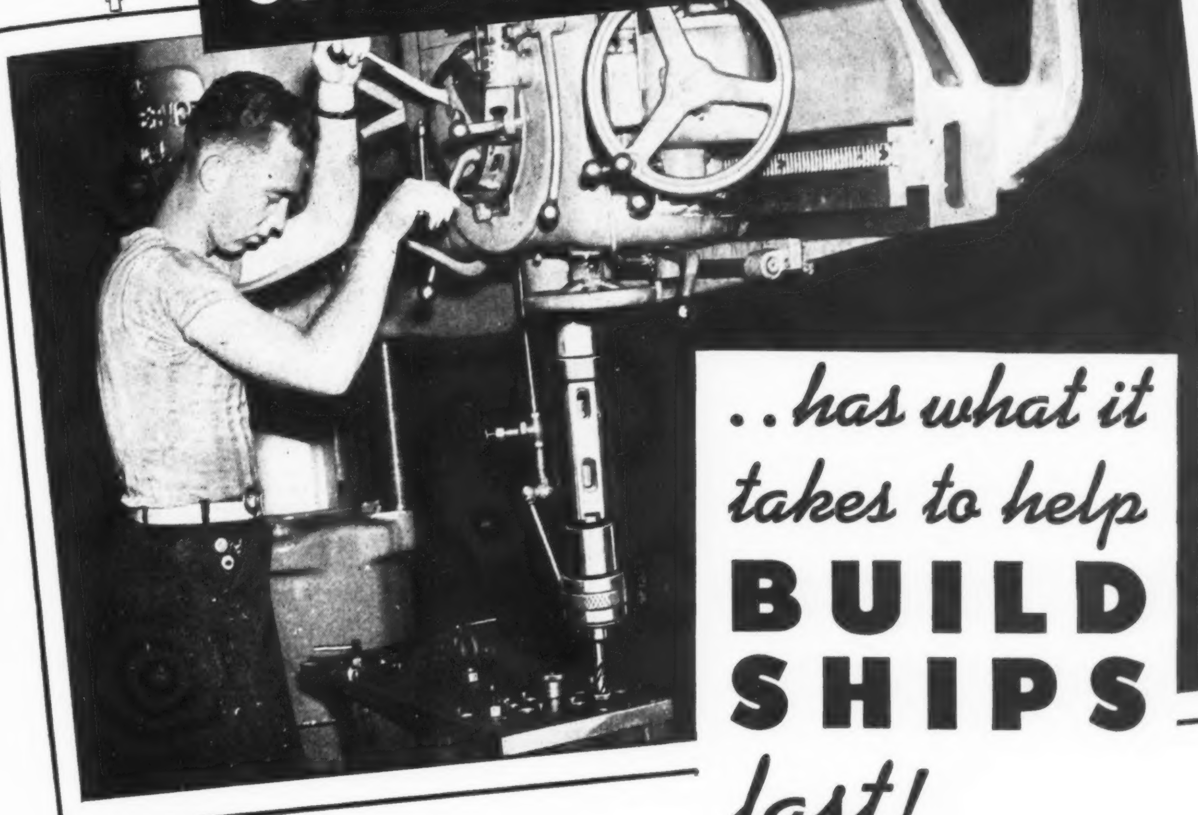
Two types of machines—a light-duty Series LTM and a heavy-duty Series HTM—are available. Machines of intermediate capacities can also be furnished. The light-duty machine is designed for tapping holes in sizes up to 7/8 inch in diameter and 14 pitch in steel. A lead-screw is employed to assure threads of accurate pitch, the tapping spindle being driven at a point between the tap and the lead-screw itself to avoid inaccuracies due to torque distortion in the lead-screw. The lower end of the tapping spindle is guided throughout the entire stroke to insure against over-size tapping of holes and to permit accurate deep-hole tapping.

The light-duty machine, shown in Fig. 1, has a fabricated base and a 4-inch steel column on which the motorized tapping head is mounted. The complete tapping mechanism can be raised and lowered on the column through a worm and a rack and pinion mechanism to adjust the height to suit the work being handled.

To obtain additional information on equipment described on this page, see lower part of page 232.

The Cincinnati Bickford

SUPER SERVICE RADIAL



..has what it takes to help

BUILD SHIPS

fast!

Marine engine output must keep pace with record-breaking shipbuilding . . and American plants engaged in marine engine production are more than fulfilling their contracts. Vitally important in this production program are the numerous Super Service Radials now engaged in shipbuilding and kindred operations, of which a good example is illustrated in the above photograph. The job shown, as performed in a prominent eastern plant, calls for drilling a number of holes to exact locations in high pressure blade rings for Marine Turbines. Although production figures cannot be published, it is obvious that the Super Service Radial has what it takes to help maintain the record-breaking pace in American shipbuilding practice.

ARMY E NAVY
AWARDED SEPT. 10, 1942

Full details concerning the advantages of Super Service Radials will be sent upon request

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THE CINCINNATI BICKFORD TOOL CO.

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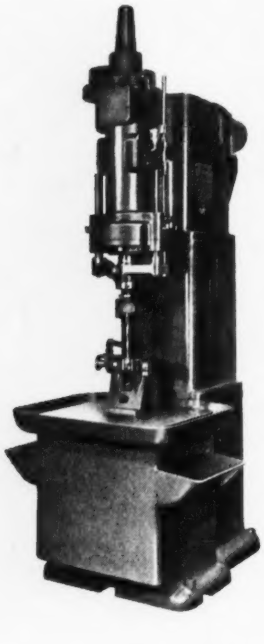


Fig. 2. Detroit Heavy-duty Tapping Machine

The maximum stroke of 6 inches is controlled by adjustable trip-dogs and limit switches which, in combination with a reversible type motor, provide automatic operation of the machine during the tapping and return stroke cycle. Multiple tapping heads can be swiveled horizontally through an arc of 90 degrees. A cone pulley and double V-belt drive provide three spindle speeds ranging from 100 to 400 R.P.M. The drive also includes a spring-loaded, adjustable safety clutch designed to prevent tap breakage.

To change the machine for tapping threads of different pitches, it is only necessary to remove the dust-cap and one screw, after which the lead-screw and nut assembly can be removed and replaced as a unit.

The heavy-duty tapping machine shown in Fig. 2 is provided with pick-off change-gears between the spindle and the drive to permit the spindle speeds to be changed to suit requirements. Positive drive is provided from a direct-coupled reversing motor of 15 H.P. maximum capacity, while a shear pin and a flexible coupling serve to protect the machine against motor vibration, tap breakage, and damage to the work. A maximum stroke of 8 inches permits the machine to be used for long taper lead tapping, for cutting oil-grooves, and similar operations. 65

Fitchburg Adjustable Angular-Head Grinding Machine

A Type C angular-head grinding machine designed to handle a wide range of grinding work is a recent product of the Fitchburg Grinding Machine Corporation, Fitchburg, Mass. This cylindrical grinder has a standard Bowgage wheel-head unit mounted so that it can be located for grinding at any angle from 0 up to 45 degrees. The head goes through a completely automatic cycle, which includes rapid traverse to work, feed, grinding dwell, and rapid return.

The work-head is adjustable for various lengths of work, and the work-spindle can be equipped for constant or variable speeds. The wheel-truing device, mounted on the work-table, is hand-operated. The wheel-spindle is ground and lapped to a mirror finish, and runs in lead-bronze bearings which are adjustable for wear. The spindle is lubricated from a tank within the wheel-head by a small gear pump.

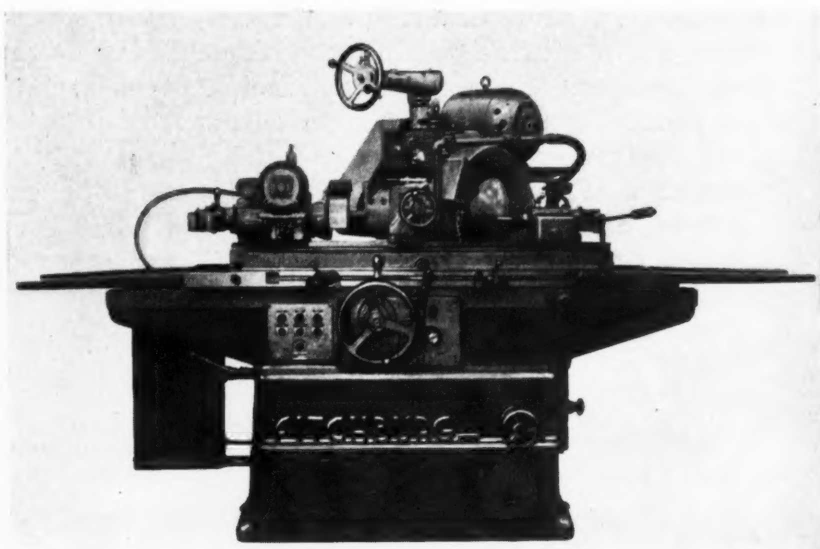
The wheel-head and table run on a large V-way and flat ways. A unique spring tension arrangement for the wheel feed eliminates feed-screws, bearings, and joints, so that there is no backlash. This feed method gives a vertical to horizontal ratio of approximately 250 to 1, and assures sensitive control for machining work to within a tolerance of 0.0001 inch. The table traverse reversal mechanism is designed for accurate shoulder grinding.

Individual motor drive is provided for the Bowgage wheel-head unit, table traverse, work-spindle, and coolant pump. Each of these motors is provided with belt-tension adjustment and push-button control.

The maximum swing over the table is 8 3/4 inches, and the maximum distance between centers 32 inches. There are five work speeds ranging from 64 to 327 R.P.M. Stepless adjustment of the table speeds ranges from 28 to 188 inches per minute. The wheel-head rapid traverse is set for a range of from 0 to 5 inches. The automatic wheel feed is adjustable from 0 to 0.090 inch. Automatic grinding cycle dial adjustment ranges from 0 to 30 minutes. The grinder occupies a floor space of 110 by 68 inches, and weighs 6500 pounds. 66

Portable Coolant Pump Systems

A complete line of portable coolant pump systems known as "Spiegel-Spray" is being manufactured by the G. B. Spiegel Corporation, 3958 S. Calumet Ave., Chicago, Ill. These pumps are suitable for 24-hour production use on lathes, screw machines, drill presses, grinders, milling machines, and for various finishing operations, including tapping, etc. They are made in capacities ranging from 150 to 1500 gallons per minute and with tanks holding from 3 1/2 to 15 gallons of coolant.



Fitchburg Cylindrical Grinder with Adjustable Angular Head

To obtain additional information on equipment described on this page, see lower part of page 232.


ARMY
E
NAVY
And now...
Three flags wave over all Ex-Cell-O plants today . . . the Stars and Stripes, as always, the first U. S. Treasury "Bull's-Eye," and now—the coveted Army-Navy "E" . . . each a badge of honor, a medal for distinguished service to the Nation. ★ ★ ★ Exceptional achievement in the production of war materials early earned Ex-Cell-O the "E" pennant (for instance, every plane made in the United States, no matter where its ultimate destination, has precision parts made on Ex-Cell-O machines). ★ ★ ★ The "Bull's-Eye" flag signifies that Ex-Cell-O was the first firm in the United States where more than ninety per cent of the employees agreed to put ten per cent or more of their pay into War Bonds. ★ ★ ★ Flying proudly alongside Old Glory, these two pennants proclaim the unified determination of Ex-Cell-O's many thousands of workers and the management . . . to promise solemnly to America's gallant fighting sons that, as it always has, so Ex-Cell-O always will, back them up with everything it's got!
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XLO
EX-CELL-O means PRECISION
EX-CELL-O MANUFACTURES PRECISION THREAD GRINDING, BORING AND LAPPING MACHINES, TOOL GRINDERS, HYDRAULIC POWER UNITS, GRINDING SPINDLES, BROACHES, CUTTING TOOLS, DIESEL FUEL INJECTION EQUIPMENT, R. R. PINS AND BUSHINGS, DRILL JIG BUSHINGS, PRECISION PARTS

Special features include non-clogging centrifugal pump with no gears or close fitting parts to wear or jam; no metal-to-metal contact; removable strainer; complete portability; self-contained unit; accurate flow control valve that permits delivering just the right amount of coolant with a spray nozzle at the exact point where it is needed....67

Metal Etcher Made by Ideal Commutator Dresser Co.

Giant Welding Positioners

The Cullen-Friestedt Co., 1305 S. Kilbourn Ave., Chicago, Ill., has added two new giant size C-F positioners to its line of welding equipment. The Model 200 positioner has a capacity of 20,000 pounds at a point 20 inches from the table and 8 inches off center, while the Model 300 has a capacity of 30,000 pounds at a point 24 inches from the table and 18 inches off center.

Like others of the C-F line, these new giant size positioners swing large heavy assemblies around as easily as one can turn a small piece of steel in the hand. Each positioner is mounted on a single pedestal which is adjustable for height, and has a table which revolves completely around and tilts to any position up to 135 degrees with the horizontal, either up or down. These positioners are motorized, and are operated by a push-button panel, so that the welder can swing and tilt the work to any position without using cranes or employing a handling crew.....68

Welding Positioner Brought out by Cullen-Friestedt Co.

Metal Etcher for Machine Shop and Tool-Room

The Ideal Commutator Dresser Co., 1011 Park Ave., Sycamore, Ill., has introduced on the market a No. 18 electric etcher for permanently marking anything made of steel, iron, or metal alloys. In etching numbers, names, or other notations on small tools and parts, the work is simply placed on the work-plate, a switch turned on to give the proper heat, and the etching started. A clamp attached to the work-plate is provided for use in etching large heavy parts and castings. The complete etching equipment, weighing 32 pounds, is enclosed in a compact case when not in use.

Hi-Lo taps and a seven-point switch give fourteen etching heats provided by current capacities ranging from 115 to 1300 watts. A red lamp at the front of the etcher indicates when power is on, and burns brighter as each higher heat is used. The depth of the mark etched can be controlled by the speed with which the writing or etching point is moved.....69

Standardized Drillmatics

A complete line of automatic and semi-automatic drilling machines, known as D S E Drillmatics, has just been placed on the market by D S E Machinery, 5187 E. Outer Drive, Detroit, Mich. These machines, built in three sizes, cover a drilling range of from No. 60 (0.040 inch) drills up to 3/8-inch drills in steel, and have a stroke of 3/4 to 1 1/4 inches. They are of either the horizontal or vertical type, or a combination of both, and are of single-, double-, triple- or quadruple-spindle construction.

The machines, in general, consist of a substantial cast-iron base with a built-in coolant pump unit, a T-slotted table for mounting fixtures, and the automatic drilling unit. The drilling units are self-contained, and have direct motor drive and automatic cycle control with rapid advance, feed, and rapid return. The cycle control for the units can be arranged for either simultaneous or successive operation.....70

To obtain additional information on equipment described on this page, see lower part of page 232.

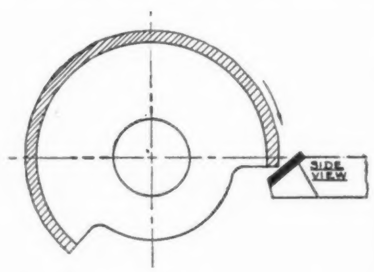
DO'S AND DON'TS FOR OPERATORS USING CARBIDE TOOLS

Carbide tools are as easy to use as ordinary types of tools. However, because carbide tools are extremely hard—and therefore more "brittle" than steel tools, certain requirements are necessary in order to protect the carbide tip while in use. When properly used, carbide tools will give you long, continuous periods of cutting, they provide high quality finish, extreme accuracy, and freedom from frequent tool changes. Here are some of the things you can do to get the most from your carbide tools.

Handy charts containing these hints are available free on request.

New Standard-Design Shear Type Tools

For interrupted cuts on large forgings and castings, the standard-design shear type Carboloy Cemented Carbide Tool illustrated has several outstanding advantages. Designed to protect the carbide tip on this heavy work, this tool takes the



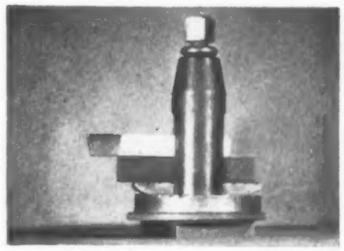
initial load at a point some distance behind the nose, where the tool is stronger. The heavy shear angle causes the cutting edge to literally "slice" into the work, thus reducing impact to a minimum. See new catalog GT-142, page 9.

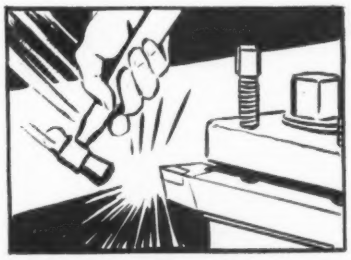
Standard-Design Tools Save Delivery Time

To enable you to order by tool number and eliminate delays for drafting, blueprints, quotations, etc., Carboloy Company now makes available a large selection of standard-design tools. These are former special tool styles for which there previously has been a large demand within a narrow range of minor design variations. Standard designs for these have been established to broadly meet most previous requirements. Standard-design tools represent one of several time-saving features described in the new catalog GT-142. Send for your copy.

◀ When using holders, use special ones designed to hold carbide tool on a horizontal plane—not tilted upwards.

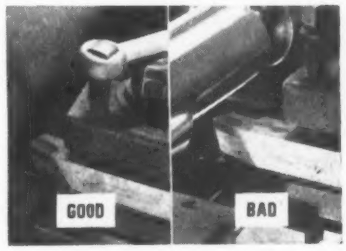
Don't tilt rocker ▶ holders up. Keep tool level and shim up to centerline. Better yet, turn tool post collar upside down to get flat surface.





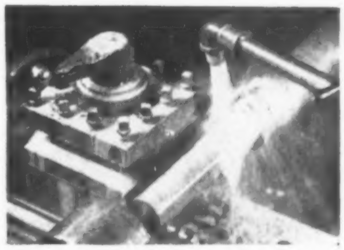
◀ Don't hammer cutting edge of carbide tools. Blows cause chipping. If necessary, tap tool from rear to bring up to work.

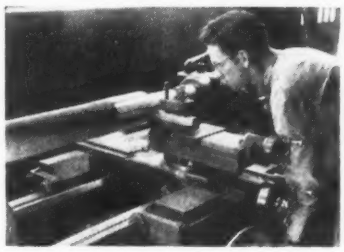
Avoid excessive ▶ tool overhang. It should be no more than necessary to allow work clearance and chip room.



◀ Don't use sharp-pointed or cup-type screws. Grind them flat—using the flat face of a cup-type grinding wheel.

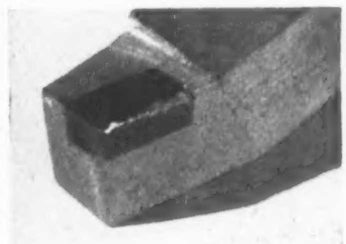
When a coolant is ▶ needed—use a *heavy* flow directly onto tool. During tool adjustments, avoid turning coolant on and off. If necessary run first piece dry.





◀ *Always* disengage feed first before stopping machine. Never stop tool in the cut. This will cause tool breakage.

Remove tool be- ▶ fore it becomes excessively dull, or chipping may result. Best way is to remove tools for sharpening at regular intervals.



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South Bend Floor Type Turret Lathe

A new floor type turret lathe has recently been brought out by the South Bend Lathe Works, Department M2, South Bend, Ind. This lathe is designed for the rapid production of small chucking or bar work to close tolerances, and will handle second-operation work efficiently. It has a 10-inch swing over the bed or saddle wings, a 1 3/8-inch hole through the headstock spindle, and a collet capacity of 1 inch.

The lathe is equipped with both a compound-rest cross-slide and a hand-lever cross-slide, which are interchangeable. The latter is furnished with front and rear toolblocks which provide positions for three tools. A quick-change gearbox supplies forty-eight longitudinal power feeds for the universal carriage, forty-eight power cross-feeds for the compound-rest cross-slide, and forty-eight thread cutting feeds that cover a range of from 4 to 224 per inch.

South Bend Turret Lathe Designed for Chucking or Bar Work

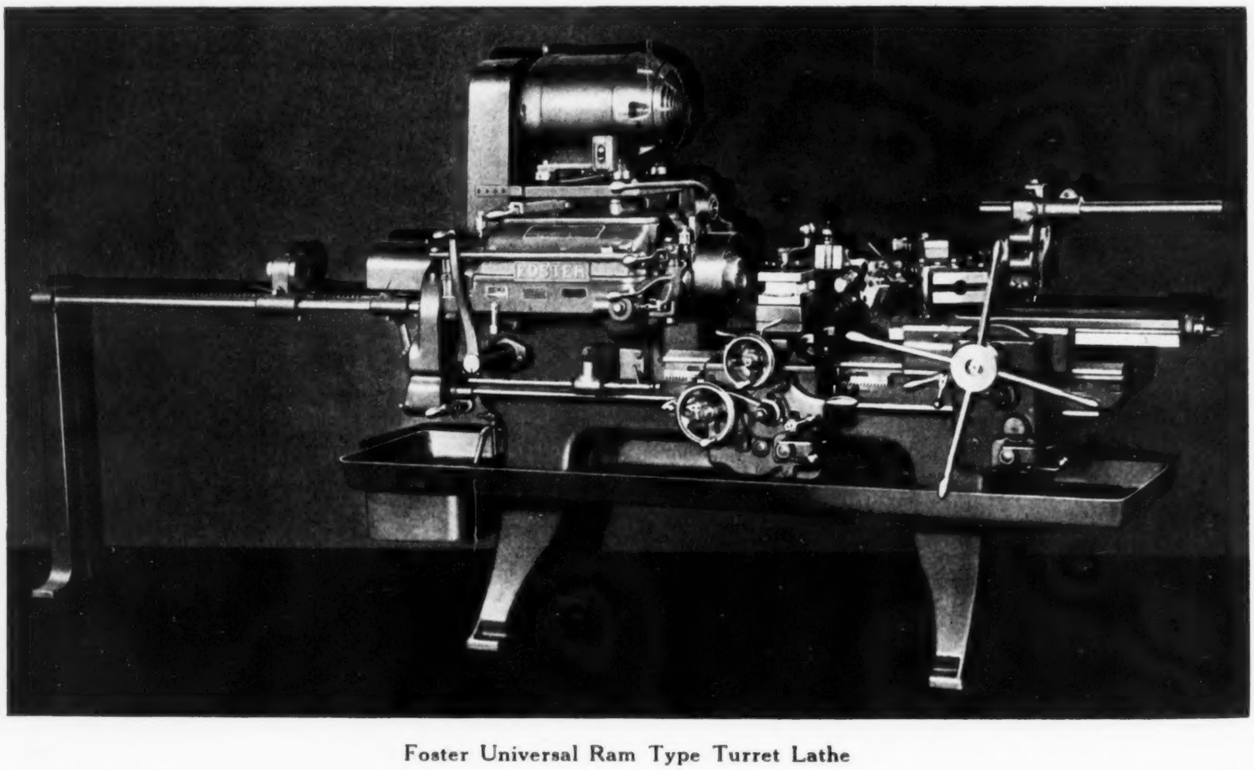
The hand-lever operated turret indexes automatically and has an adjustable stop for each of six turret tool positions. The underneath motor drive and back-gears provide twelve spindle speeds ranging from 50 to 1357 R.P.M. This lathe is furnished either with or without coolant equipment. A wide range of attachments is available. 71

Foster Universal Ram Type Turret Lathe

A universal ram type turret lathe, known as the No. 5, with a collet chuck capacity of 2 inches and a swing over the ways of 17 1/2 inches is being brought out by the Foster Division of the International Machine Tool Corporation, Elkhart, Ind. The machine is supplied complete with tools for both bar and chucking work, and will accommodate chucks 8, 10, and 12 inches in diameter. In addition, it can be equipped with special attachments, including bar feeds and collet chucks, and taper and threading attachments for handling various types of turret lathe work.

The all-geared headstock provides eight spindle speeds, which are controlled by three levers mounted on top of the headstock. Individual motor drive is provided, power being transmitted by silent-operating multiple V-belts. Any one of various types of motors can be selected, depending upon the work to be handled. Motors of 3, 5, and 7 1/2 H.P. are regularly furnished, which operate at speeds of 1200 or 1800 R.P.M. When both low- and high-speed spindle ranges are required, a 7 1/2-H.P., two-speed motor is used which operates at 1800 and 900 R.P.M.

The universal carriage is provided with six reversible cross and longitudinal feeds which operate independently of the hexagonal turret carriage. Quick-acting levers disengage the feed by a slight touch of the hand, or the levers can be set to automatically disengage the power feed at predetermined points. Feeding is accomplished by a pinion and rack mounted on the bed. Adjustable feed trip-dogs are furnished for the cross-slide, and a six-screw stop-roll is provided for the longitudinal travel of the car-



Foster Universal Ram Type Turret Lathe

To obtain additional information on equipment described on this page, see lower part of page 232.

REMEMBER, SON, FINE TOOLS DESERVE PROPER CARE!

Keep Your Turret Lathes Properly Leveled

Lubricate Your Machine at the Start of Each Shift

GISHOLT

★ *Reprints of this page are available free for bulletin board use in your turret lathe department. Write the Gisholt Machine Company, 1209 East Washington Avenue, Madison, Wisconsin. Ask for "Care and Operation Poster No. 1." State quantity desired.*

riage. Hand feeding to obtain the desired dimensions is facilitated by a large micrometer dial graduated in thousandths of an inch.

A cross-slide holds the quick-indexing square turret at the front, and the rear of the slide is drilled and tapped for holding rear and forming tool holders. The hexagonal turret carriage is provided with six power feeds to the ram slide in the forward direction, which are engaged by a quick-acting lever on the turret apron. The hexagonal turret is automatically unclamped, indexed, and reclamped by means of the four-spoke pilot wheel which controls the forward and reverse movement of the ram slide.

A taper attachment can be supplied as extra equipment which is bolted directly to the bed casting and the rear of the cross-slide. The taper guide for the rear tool-block is held by a bar and bracket which can be adjusted to cut a taper at any position within the capacity of the attachment. The taper attachment will cut a taper of 3 inches per foot in lengths of 6 inches or less. A threading attachment can also be supplied for chasing accurate threads. 72

Carborundum Abrasive Wheels

A new line of abrasive wheels, designated MX, for use without coolant and on any type of flexible-shaft machine or hand grinder, has been brought out by The Carborundum Company, Niagara Falls, N. Y. This new line of wheels has a wide application in the finishing and polishing of inaccessible surfaces on airplane engine parts and similar work, including breaking down burrs or sharp edges on gear teeth, finishing and polishing spline grooves, all types of under-cuts, and recesses or cavities. Polishing internal surfaces and smoothing sharp edges of holes can also be accomplished with these wheels.

The MX wheels are made up of thin disks of cotton fibers impregnated or mixed either with Aloxite Brand aluminum oxide or Carborundum Brand silicate carbide. The thin disks are bonded together or built up in the form of resilient and flexible wheels. The result is a clean, free-cutting wheel, which gives a light stock removing and high polishing action with the application of but little pressure. The wheels should be mounted between relieved flanges, and should be dressed with an abrasive stick.

The recommended operating speeds range from 6000 to 8000 surface feet per minute. The wheels are made in six grades ranging from Nos. 1 to 6. The harder grades (Nos. 1, 2, and 3) are recommended for use on work having a more severe dressing action on the wheel. The softer grades are recommended for use in polishing small plain surfaces. 73

Standardized Shell Taps

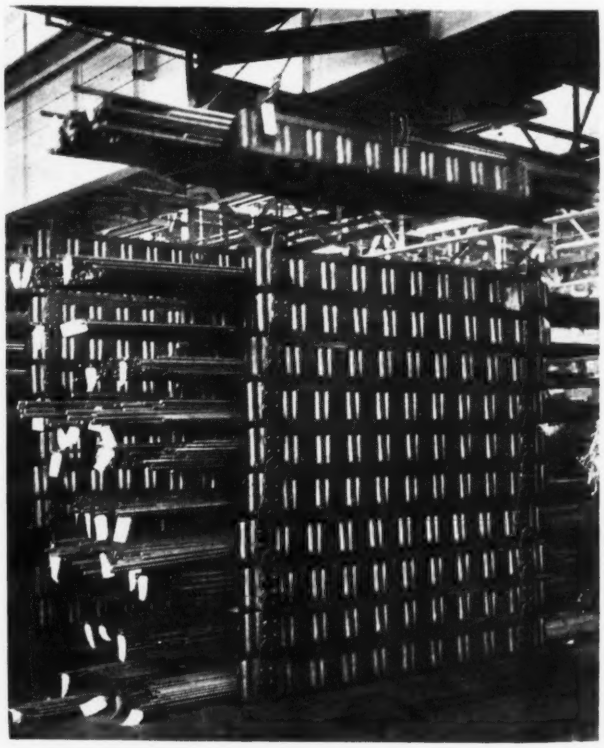
A line of special taps for tapping both ends of 40- and 20-millimeter shells is now being produced by the Detroit Tap & Tool Co., 8432 Butler St., Detroit, Mich. This new line of taps was developed as a result of an extensive field survey made by this company. 74

Bar Stock Racks

A new type of materials-handling unit has been designed by the Union Metal Mfg. Co., Canton, Ohio, for the removal and storage of long bars or odd-shaped parts. This unit was originally developed to solve the problem of handling and storing long steel bars in an aircraft-parts manufacturing plant.

Essentially, the unit consists of the company's standard "All-Steel" skid platform, turned upside down and equipped with eyed brackets for the insertion of crane hooks.

Carborundum MX Abrasive Polishing Wheels



Bar Stock Rack Developed by Union Metal Mfg. Co.

To obtain additional information on equipment described on this page, see lower part of page 232.

Shells IN SECONDS..INSTEAD OF MINUTES

SUNICUT helps shell plant run complete 8-hour shifts without tool change or regrind

Shells that a short time ago required minutes to machine now are produced in seconds.

At one of America's great armament plants, batteries of automatics are turning out shells on a 'round-the-clock schedule, running complete 8-hour shifts without a tool change or regrind, and Sunicut, the transparent, sulphurized cutting oil, is a vital contributing factor.

Sunicut was adopted at the recommendation of Sun Oil Engineers—those well-known Doctors of Industry. Its success has been phenomenal. Sunicut's exceptional heat-absorbing and metal-wetting qualities permitted the increased tool life, fine finish and "nth" degree accuracy that made this production possible.

Get more production per shift in your plant. A Sun Doctor of Industry is ready . . . willing . . . and able to help you. Call on him today. For other examples of how Sun Engineers and Sunicut are helping industry step up production for victory, write for free copy of "Helping Industry Help America."

SUN OIL COMPANY • Philadelphia

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SUNOCO

WAR BONDS
STAMPS

SUN PETROLEUM PRODUCTS HELPING INDUSTRY HELP AMERICA

The corrugated construction of the rack is designed to provide added strength and durability. The racks can be handled equally well with crane, hand pallet, or power fork trucks. 75

Century Precision Boring Machine

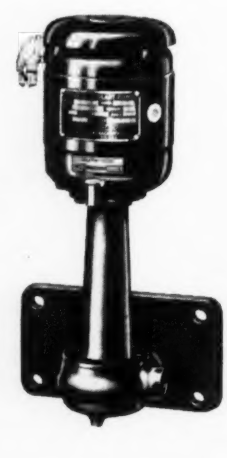
A new type bench model precision boring machine has been developed by the Century Engineering Co., 816 W. 5th St., Los Angeles, Calif. On this machine, holes from 3/8 inch to 2 3/4 inches in diameter can be quickly bored to size within close limits. Parts that have parallel sides adjacent to the hole can be held in place by a quick-acting fixture. This fixture can be removed and replaced by other work-holding fixtures designed to accommodate unsymmetrical parts, and it can be arranged for air and hydraulic operation.

The feed of the fixture on the slide is adjusted by means of a small hydraulic metering valve, which slowly moves the fixture with its work toward the boring-bar during the boring operation and quickly withdraws it when the operation has been completed. This arrangement insures accuracy during the boring operation, and saves time when the fixture is ready for reloading.

The 110-volt driving motor for the boring-bar spindle is housed within the lower portion of the spindle casting, where it is protected from chips. A three-sheave pulley permits changing spindle speeds. A set of locating plugs and bushings ranging in size from 3/8 inch to 2 3/4 inches in diameter is provided for use with the universal fixture. The equipment includes six boring-bars ranging from 3/8 inch to 2 3/4 inches. 76

Ruthman Gusher Coolant Pump

A vertical 1/10-H.P., motor-driven, gusher coolant pump, designated the Model 5-P3, has recently been developed by the Ruthman Machinery Co., 1819 Reading Road, Cincinnati, Ohio. This pump can be furnished with a discharge opening either to the right or left, the illustration showing a pump with the discharge opening to the right. The capacity of this pump is sufficient to force 10 gallons per minute through a 1/2-inch pipe at a head of 5 feet. The mounting flange is made larger to permit interchanging with larger size gusher pumps, such as the Models 11022, 11020C, and 11022E when this is desirable because of changes in the work.



Gusher Coolant Pump Made by Ruthman Machinery Co.

The impeller is the Ruthman patented twin equalized intake type designed to obtain hydrostatic balance. The mounting is very simple, only four cap-screws and a communicating gravity inlet being required. 77

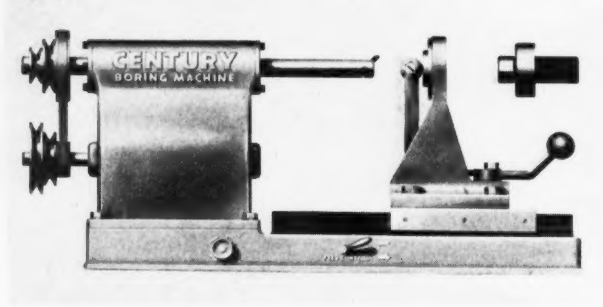
"Motorelay" Control for Machine Motors or Other Electrical Equipment

"Motorelay" Control

A device termed "Motorelay," designed for use with any floating contact device in applications where the control current exceeds the contact rating of the control instrument, has been brought out by the Barber-Colman Co., 204 Loomis St., Rockford, Ill. The unit includes a shaded pole, reversible geared-head motor, totally enclosed switches, and switching mechanism. An enclosed type drawn steel cover is available. Switch contacts have a non-inductive load capacity of 10 amperes at 110 or 230 volts on main current. The control circuit current is 0.35 ampere at 25 volts. 78

Detroit Tap Reconditioning Machine

A tap reconditioner of increased capacity is announced by the Detroit Tap & Tool Co., 8432 Butler St., Detroit, Mich. The improved machine can handle all sizes and types of taps up to 1 1/4 inches in diameter, including long-shank taper taps. This has been made possible by providing a "through" hole



Precision Boring Machine Developed by the Century Engineering Co.

Detroit Tap Reconditioner Designed for a Wide Range of Work

To obtain additional information on equipment described on this page, see lower part of page 232.

in the tap chamfering head. The spiral-pointing unit has also been improved. The machine is designed for spiral-pointing and polishing operations, in addition to chamfering taps. 79

Anker-Holth Air-Operated Chuck

Approved for Publication by the War Department

Drill presses, as well as lathes and vertical milling machines, can be quickly converted into production machines by the use of air cylinders and air-operated chucking devices brought out by the Anker-Holth Mfg. Co., Chicago, Ill. A drill press equipped with the new Anker-Holth combination air cylinder and air-operated three-jaw universal chuck, used for performing all internal machining operations on 40-millimeter high-explosive shells, is shown in the accompanying illustration. These combinations are being made in sizes for holding from 37- up to 105-millimeter shells.

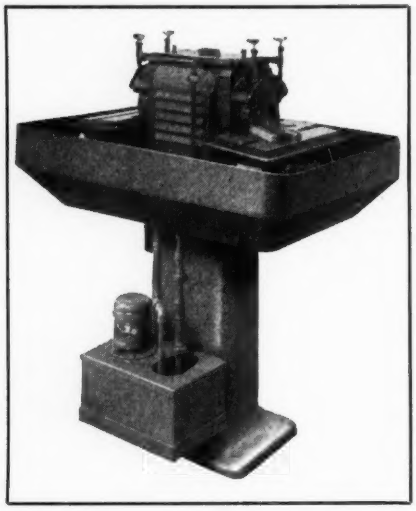
The chuck can be operated by either a foot- or a hand-valve. It will grip work internally or externally, and will exert clamping pressures up to 75,000 pounds when operated by air at a pressure of 100 pounds per square inch. 80

Anker-Holth Air-operated Shell Chuck

Double-End Carbide-Tool Grinder

A new double-end grinder has been placed on the market by Willey's Carbide Tool Co., Detroit, Mich. Its design incorporates all the recent improvements developed by this company to assure efficient free-hand grinding of tungsten-carbide tipped tools, as well as other types of tool bits. It is furnished with a coolant pump and pan for wet grinding operations.

The motor is of special design, and is available for operation on 220- or 440-volt, 60-cycle, three-phase current at a speed of 3450 R.P.M. The tool-rest table is adjustable to all angles between 30 degrees toward the wheel and 30 degrees from the wheel. The table is also adjustable to compensate for wheel wear. 81



Double - end Carbide - tool Grinder Made by Willey's Carbide Tool Co.

Koehler Turret Heads, Carriage Stops, and Boring-Tool Holders

The Master Machine Co., 19 Grove St., Stamford, Conn., is placing on the market a line of turret heads, carriage stops, and toolholders manufactured by the Koehler Instrument Co. The turret head is available in a Model A type for holding six tools, as shown in Fig. 1, and in a Model B type for holding eight tools.

The Model A turret head, using 5/16-inch tool bits, can be employed on most lathes of from 9- to 12-inch swing when the distance from the top of the compound rest to the spindle center line is from 1 to 1 7/16 inches. An ordinary engine lathe can be converted into a semi-automatic turret lathe by simply removing the toolpost and replacing it with this turret head, which weighs approximately 12 pounds.

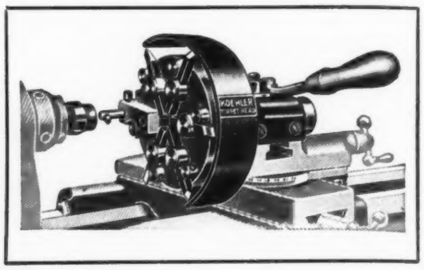


Fig. 1. Koehler Six-tool Turret Head

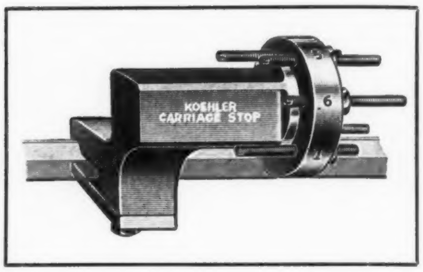


Fig. 2. Koehler Six-position Carriage Stop

The Model B eight-tool turret head uses 3/8-inch tool bits, and will fit lathes having a swing of 12 inches or more when the distance from the top of the compound rest to the center line of the spindle is 1 1/2 inches or greater. This turret head weighs about 25 pounds.

The new carriage stops, especially designed for use with these turret heads are made in Model A style with six adjustable tool stops, as shown in Fig. 2, and in a Model B style with eight adjustable stops. The boring-tool holders are also made in Models A and B styles. 82

All-Position Welding Electrode

A new electrode designed specifically for all-purpose welding of mild steel with alternating-current type welding machines has been developed by the Air Reduction Sales Co., 60 E. 42nd St., New York City, in 1/8- and 5/32-inch diameter sizes. This electrode is known as the "Airco No. 230." It

To obtain additional information on equipment described on this page, see lower part of page 232.

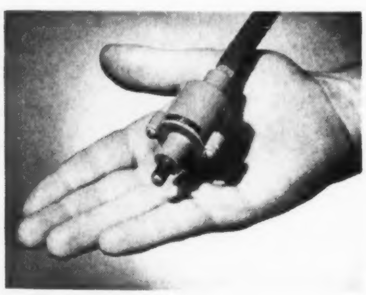
complies with all requirements of the American Welding Society's classification E6011, American Bureau of Shipping, Group H1G and B1G, for alternating current, and other specifications qualifying it for use on war work.

Physical tests on all-weld metal tensile specimens show an ultimate tensile strength of 70,000 to 75,000 pounds per square inch, and an elongation in 2 inches of 25 to 30 per cent. Specimens tested in the stress relieved condition show an ultimate tensile strength of from 65,000 to 70,000 pounds per square inch, and an elongation of 30 to 35 per cent. 83

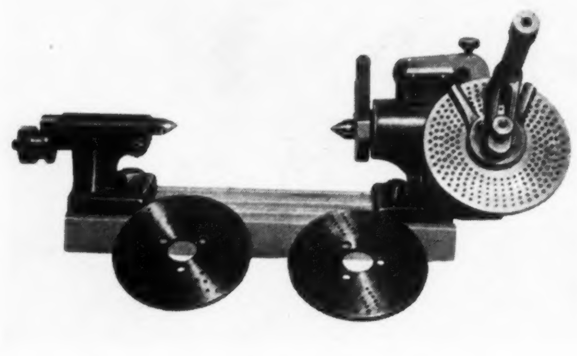
"Midget" Air-Operated Clamp

The Mead Specialties Co., 15 S. Market St., Dept. M-22, Chicago, Ill., has brought out a "Midget" air-operated clamp for use on assembly jigs and other multiple work-holding applications. This unit was designed expressly for use in the aircraft industry, but it can be employed to advantage for a wide range of work involving the joining of parts by welding, riveting, or bolting.

Any number of these clamps can be used on a set-up, and they can be operated by a single master valve, or any group of clamps can be controlled separately, whether there are two or several hundred. The clamping and releasing of assemblies can be accomplished instantaneously when these clamps are used. The compact size permits the clamps to be installed in cramped corners or inaccessible places. 84



"Midget" Clamp Placed on the Market by Mead Specialties Co.



Jefferson Plain Dividing Head with Three Dividing Plates

Jefferson Plain and Tilting Dividing Heads

In addition to the 6-inch tilting dividing head described and illustrated in June, 1942, MACHINERY, page 170, the Jefferson Machine Tool Co., 673-773 W. Fourth St., Cincinnati, Ohio, is now making the 6-inch plain dividing head shown in the accompanying illustration. This dividing head has a swing of 6 inches and an over-all length of 6 3/4 inches. The base measures 3 1/4 by 3 inches. The spindle has a No. 7 B & S taper and take-up collar for end thrust. Either a chuck or a work-fixture can be mounted on the threaded spindle nose, which is 1 1/8 inches in diameter and has twelve U.S.S. threads per inch.

Three dividing plates, each 4 inches in diameter, cover the entire range of the B & S index chart. One 24-notch rapid indexing plate, 4 1/2 inches in diameter, is also furnished. The worm-wheel ratio is 40 to 1. The dividing head weighs 30 pounds. 85

Heat-Treating Temperature Control for Salt Baths

A new temperature control for salt-bath heat-treating has been developed by the Upton Electric Furnace Division, 7450 Melville Ave., Detroit, Mich. The equipment consists essentially of a panel stand, on which is mounted a pyrometer, timer, ammeter, and signal light. Below the panel is a cabinet with three heat selector levers. The foot-operated circuit interlock unloads the hand-lever switches to avoid burning of their contact points when a change in heat selection is being made.

When the work is placed in the bath, the operator touches the starting button on the panel, and the automatic control begins to function. At the end of the predetermined time interval the coolant drops back to the "holding" value, and the signal light flashes to warn the operator that the work is completed and ready to be removed.

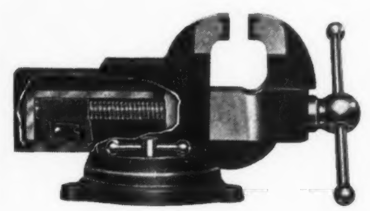
Should the operator make an error in his setting, so that the temperature rises above the correct value, the power to the bath would be shut off entirely. Too low a setting is indicated by the pyrometer in time to permit the operator to correct the error. 86

Pacific Quick-Action Vise

To eliminate waste of time in turning the handle of a bench vise to change the width of jaw opening, the Pacific Vise Co., 6331 Hollywood Blvd., Los Angeles, Calif., has brought out a new line of vises. The quick-action principle incorporated in the design of these time-saving vises involves the use of a patented nut and pawl, which makes it possible to open and shut the vise like a drawer and to lock it in any position by two turns of the handle.

When the pawl is engaged with the steel rack, as shown in the illustration, the vise is ready to grip the work. Two left-hand turns of the handle disengage the pawl and permit opening and closing the jaws freely to fit the part to be gripped. Only two right-hand turns are then needed to re-engage the pawl and grip the part firmly. It is estimated that this feature saves up to thirty minutes each day.

A new type swivel-base locking



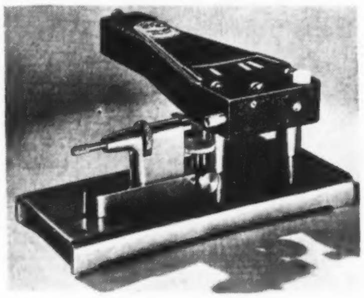
Quick-Action Vise Made by Pacific Vise Co.

To obtain additional information on equipment described on this page, see lower part of page 232.

bar with two screws assures a positive lock in any position and equalizes strain. These vises are available in three sizes of 4 1/2, 6, and 7 inches, and in both the swivel and solid-base types. 87

Trico "Micro-Check" Inspection Gage

A comparator type of gage having a simple lever mechanism for multiplying the dimensions checked under the control of a push-button has been brought out by the Trico Products Corporation, Buffalo, N. Y. This gage is set by the use of two master parts, one having the limit of dimensional tolerance on the high side, and the other having the dimensional tolerance on the low side. Two limiting figures on the instrument are set for comparing the master part with production parts, so that "Go" and "No Go" limits can be checked simultaneously. 88



Trico "Micro-Check" Comparator Type Inspection Gage

Plastic Taperlock Gage Handle

Plastic Handles for Taperlock Gages

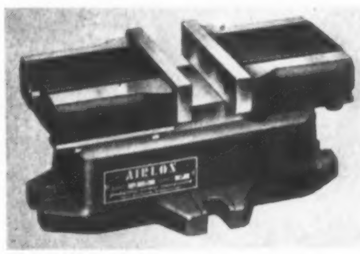
The Federal Tool Corporation, 405 N. Leavitt St., Chicago, Ill., has developed plastic Taperlock gage handles like the one illustrated to meet the need for conserving metal. These plastic handles are accurately made to the accepted standard dimensions, and are much lighter than metal handles, which permits a lighter touch and lessening of fatigue from long continued use. The plastic handles are marked with the same lettering stamps as are used for the metal ones. 89

Airlox Junior Pneumatic Vise

A quick-acting vise designed for precision milling, drilling, tapping, filing, and assembly production work, known as the Airlox Junior Colt Type, has been placed on the market by Production Devices, Inc., Main St., Poultney, Vt. This vise is operated by a special Schrader air cylinder, and is so constructed that the cylinder and mechanism are incorporated within the vise body and thus shielded from chips, lubricants, etc. Machined surfaces on top of the vise jaws permit the attachment of any special fixtures.

An instantly accessible screw adjustment of the stationary jaw enables the operator to set the jaw opening to grip the work during the last 1/16 inch of jaw travel, thereby obtaining the maximum gripping pressure, which is equivalent to twenty times the air-line pressure. Bolts can be adjusted to lock the jaw firmly in place.

These vises are regularly supplied with No. 2 Brown & Sharpe jaw-hole spacing and soft jaw faces. They can also be provided with undrilled jaw castings. The length of the vise is 10 inches, the width 5 7/8 inches, and the height 4 1/2 inches. The jaw width is 4 3/4 inches, and the depth 1 1/8 inches. The usable jaw opening is 2 1/8 inches between jaw faces or 3 inches between the jaw castings. The vise weighs approximately 25 pounds, and consumes 0.005 cubic feet of air per operating movement. 90



Airlox Quick-acting Vise for Milling and Drilling Work

Letting Workers Know How They Help the War Effort

As an inspiration to the employes in the plant to do their best to help win the war, the Mattison Machine Works, Rockford, Ill., is using a most effective method. Through a series of posters, the men are told how the machines they help to make are employed in the war effort. The products made by the machines are illustrated on these posters, and a brief explanation is given of the part played by the machine in the war production effort.

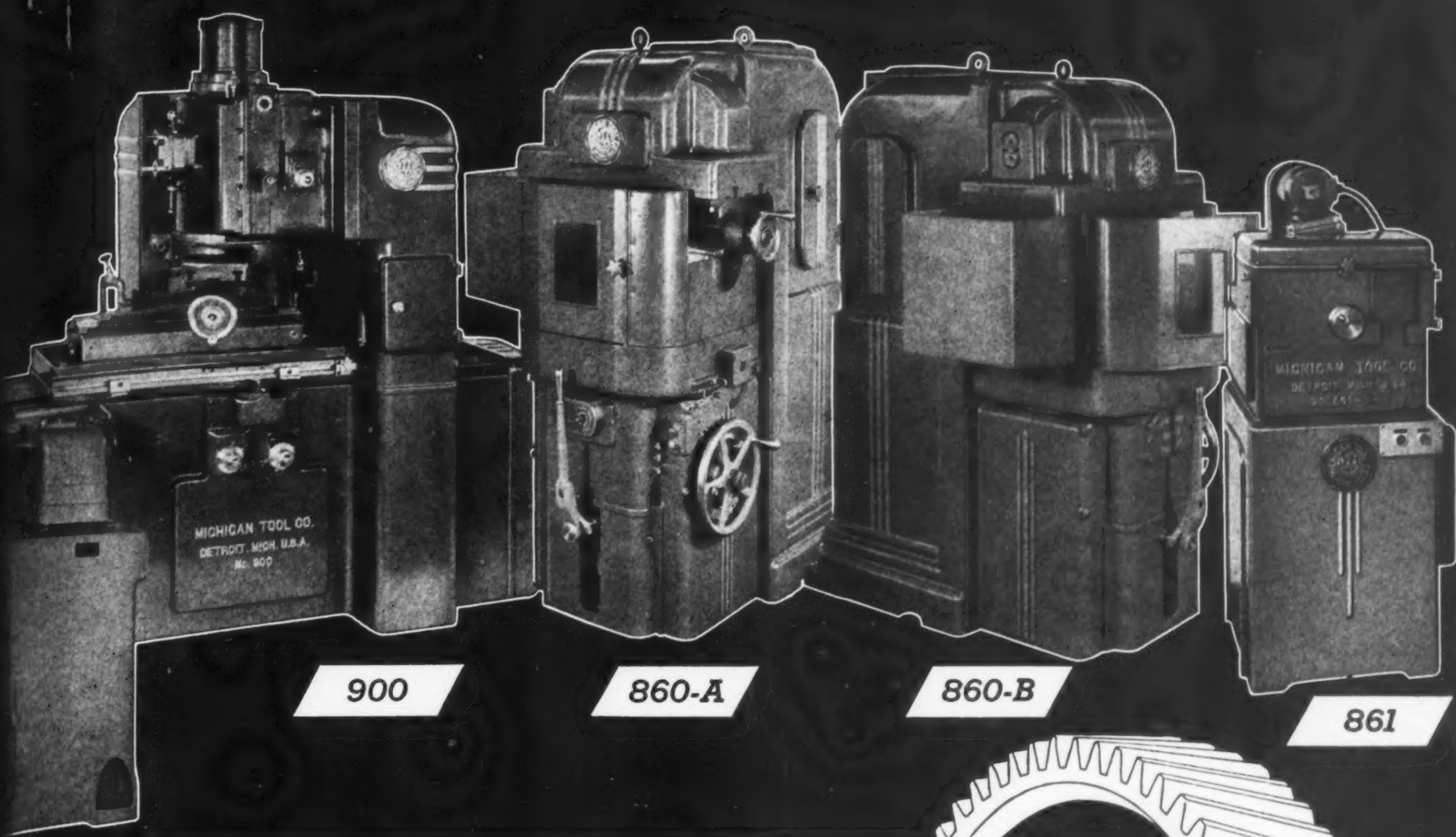
For example, one poster shows a formation of airplanes, and a Mattison machine engaged in grinding the slots in airplane motor rocker arms. In another case, anti-aircraft guns are depicted in action, and the same poster shows a Mattison machine in operation grinding breech-blocks, thirty at a time, for use in these guns, in a United States arsenal.

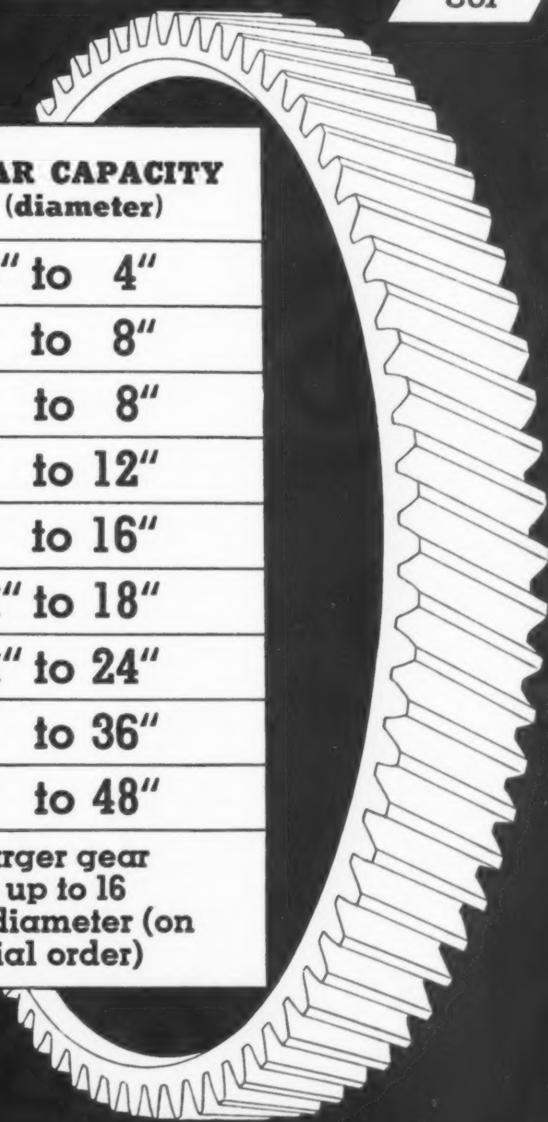
These posters are placed in conspicuous positions throughout the plant, and are changed from time to time. They serve a very definite purpose, because, in these critical times, there is nothing more encouraging to a man or woman than to know that his or her work directly contributes to the important enterprise in which the nation is engaged. Everybody wants to feel that he is doing his part.

Fluid for Making Changes on Prints

Prints made from tracings with the Ozalid process, developed by the Ozalid Products Division, Johnson City, N. Y., can be easily changed by the use of a fluid made by the same company. If changes have to be made on an Ozalid print, the part of the design that is to be changed is quickly deleted by means of Ozalid corrector fluid. When the lines have disappeared, the print is dried with a desk blotter, and the draftsman simply draws in the new design right on the print, which is transparent, so that it, in turn, can be used to produce any number of duplicate prints for shop use incorporating the required change.

To obtain additional information on equipment described on this page, see lower part of page 232.





MACHINE MODEL NO.	GEAR CAPACITY (diameter)
861-4B (Light Duty)	¼″ to 4″
900 (Rack Type)	1″ to 8″
860-(A or B)-8	1″ to 8″
860-(A or B)-12	1″ to 12″
860-(A or B)-16	1″ to 16″
862-18 (Heavy Duty)	2¼″ to 18″
862-24 (Heavy Duty)	2¼″ to 24″
865-36 (Heavy Duty)	4″ to 36″
865-48 (Heavy Duty)	4″ to 48″
865- ? ? ? (Heavy Duty)	for larger gear sizes up to 16 feet diameter (on special order)

MICHIGAN TOOL COMPANY

7171 E. McNichols Road — Detroit, U.S.A.

Effective Way of Reducing Absences

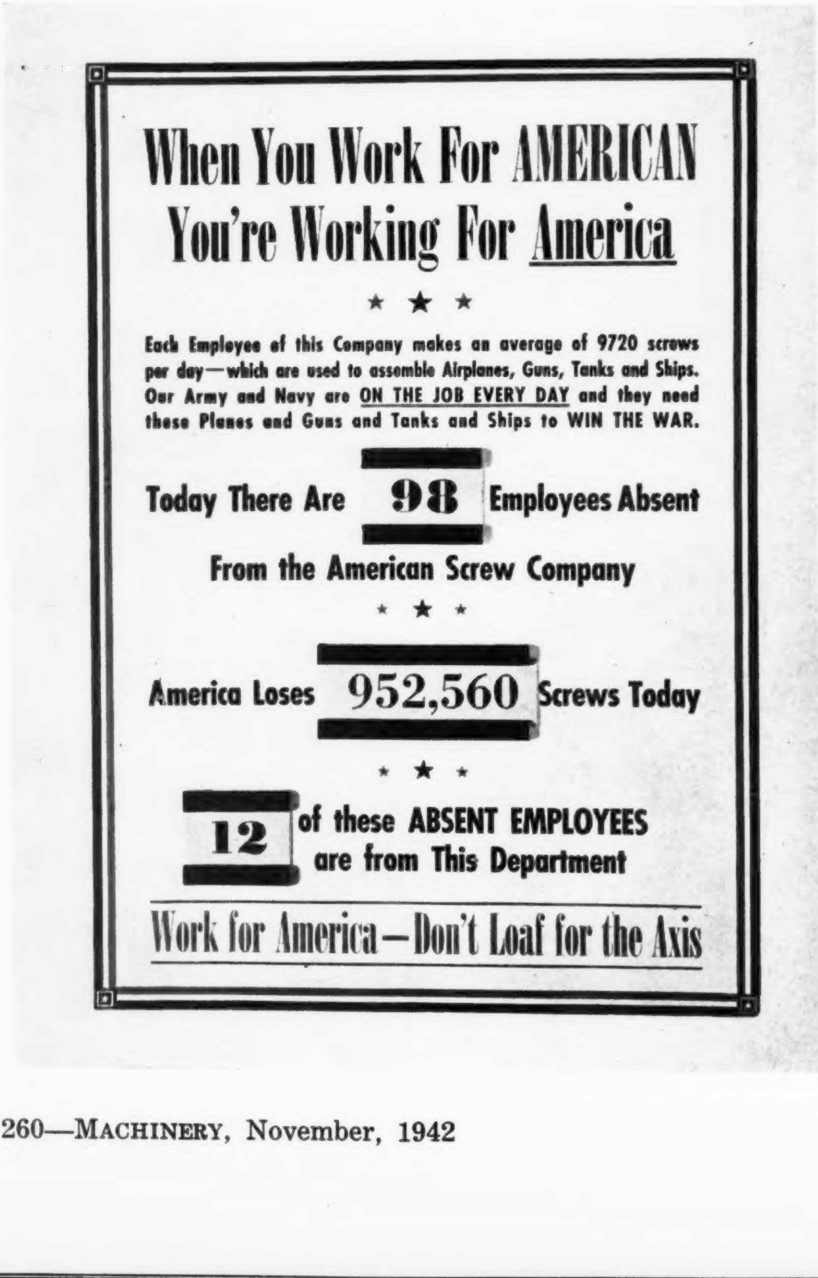
The habit of staying home from work in war plants is becoming a major management problem in many shops. It is a serious drawback to the war production effort.

The American Screw Co., Providence, R. I., found that, on an average, almost 10 per cent of the workers in the plant were absent each day. Most of the absences were found to be due to no more serious cause than the worker's desire to "take a day off." Many of the workers feel that they can afford to do this from the financial point of view, because their weekly pay envelope, due to the war conditions, still appears ample to them. Each absentee apparently thinks that one man's work out of 1300 in the plant would not be missed.

In an effort to check this growing tendency, the company devised a chart showing the average number of screws produced by each employe per day, the total number of employes absent each day, the total amount of production lost in the plant due to such absence, and the number of workers absent in each department. This chart is posted in each department. It shows to the workers in actual figures, day by day, how vital war production is affected by a single day's absence of one employe.

It is gratifying to report that the effect of this poster was noted immediately. The first week that the plan was in operation the number of absentees dropped steadily to less than one-half of what it had been the previous week; in fact, four departments, during the first week, reported no men absent.

The American Screw Co. is anxious to assist other plants in the installation of this plan, as a contribution to the national war effort. The chart, reproduced herewith, is printed in red, white, and blue in the original. It is mounted on heavy pasteboard, so that it can be conveniently hung in a prominent place. There are three slots into which the number of employes absent in the entire plant, the estimated loss of production for the day, and the number of workers absent in a particular department can be inserted each day.



* * *

Sundstrand Receives Army-Navy Award

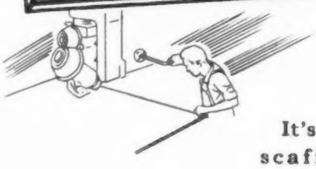
The Sundstrand Machine Tool Co., Rockford, Ill., has received the Army-Navy "E" Award for excellence in production. At ceremonies held in Rockford, the Award Flag was presented by Brigadier General John M. Willis, Commanding General at Camp Grant, to Hugo L. Olson, president of the Sundstrand Machine Tool Co. In presenting the flag, General Willis said to the officers and men of the company that, while their work was carried on far from the thrills and excitement of combat, it was every bit as important as that of the men who fire the guns, drive the tanks, or fly the planes. "You workers," he said, "who are producers of materiel necessary to carry on the war, are truly the unsung heroes of today."

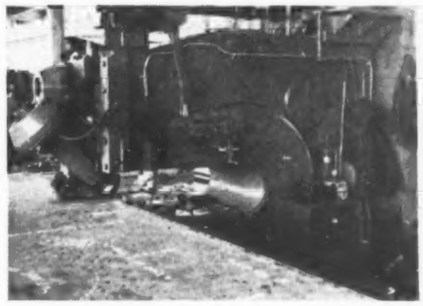
Lieutenant W. R. Teller, Jr., Industrial Relations Officer for the Ninth Naval District, presented the Army-Navy "E" pins to employe representatives. In so doing, he said: "The Navy salutes you for your devotion to duty and excellence in production." John Darby, an employe of the company, who accepted on behalf of the workers the "E" pin that each worker is entitled to wear, replied: "Behind the bench, the lathe, the drill press, or wherever our duty is, we will redouble our efforts. We have to keep our armed forces supplied with materiel at all costs. We will not let them down."

* * *

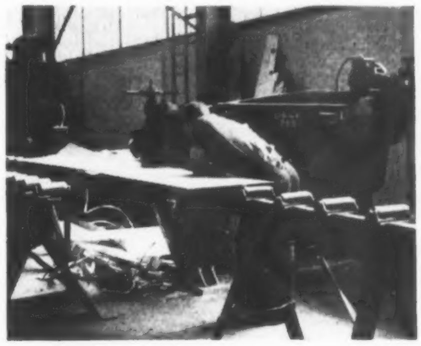
According to information distributed by the Automotive Council for War Production, deliveries of war products from automotive plants during September were valued at $512,000,000. This is equal to an annual rate of production of over $6,000,000,000.

QUICKWORK Rotary Shears
Help Make the Parts That Make the Ships





Quickwork Rotary Shear shown cutting heavy gauge steel sheets at Bath Iron Works.



Many Quickwork Rotary Shears are in use at the New York Shipbuilding Corporation. This is a No. 25-A Shear, capacity up to ¼" mild steel.

It's a maze of scaffolding, cranes, machines, and men. The scrambled parts of a giant jig-saw puzzle are fitted together... and in record time another great ship takes to the sea to help win our war of supply.

Many of those "jig-saw" parts are made FASTER by using the Quickwork-Whiting Rotary Shear. This versatile machine cuts steel plate—produces circles, flanges, strips—joggles for riveting, bevels for welding—all at amazing speed. It is equally adapted to job or production shop work. It conserves machines and manpower.

It will pay you to investigate the advantages of Quickwork-Whiting shears as applied to your own war production problems.

Your "QUICKWORK" does other jobs, too

Your Quickwork Shear will also:

- Cut straight lines
- Cut narrow strips
- Cut circles
- Cut openings and irregular shapes
- Cut beveled edges
- Flange and joggle
- Make clean cuts without burrs—in a single pass at high speeds.

Don't wait for a new machine. Use your Quickwork.

"QUICKWORK" WHITING

Division of Whiting Corporation, 15673 Lathrop Ave., Harvey, Illinois

Awards Made in the Lincoln Foundation Welding Contest

Men in the machinery industries figured prominently in the awards announced last month in the $200,000 welding study program sponsored by the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio. In the machinery manufacturing industry, the following men received the chief awards:

John L. Miller, chief metallurgist, Gun-Mount Division, Firestone Tire & Rubber Co., Akron, Ohio, won the second grand award amounting to $11,200 for a treatise on the redesign for welding of the 40-millimeter Bofors anti-aircraft gun, outlining how various parts were changed from riveted to welded design. The total savings for each 10,000 units are estimated at approximately $1,750,000.

The third grand award of $8700 was won by H. Thomasson, welding engineer of the Canadian Westinghouse Co., Ltd., Hamilton, Ontario, for a paper describing welding in connection with the manufacture of a new type of large mercury-arc rectifier.

Regis F. Fey, structural engineer with the Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa., was awarded $2700 for his treatise on the design, function, construction, cost, and features of a welded 1000-ton per day blast furnace. This blast furnace was constructed in eight months time, compared with twelve months for the conventional construction. The total reduction in cost was over $150,000.

Peter J. Gurklis, superintendent of the boiler shop of the Dow Chemical Co., Texas Division, Freeport, Tex., was awarded $2500 for his paper on electric welding of copper bus-bars.

C. Perry Streithof, structural division engineer of the Dravo Corporation, Pittsburgh, Pa., was awarded $1700 for a description of a revolving gantry crane for shipbuilding. A similar amount was awarded to R. S. Conabee, engineer with Lukenweld, Inc., Coatesville, Pa., for a paper dealing with the welding of a light-weight paper-making machine.

A description of the welding of 30,000-H.P. water turbines by Herbert Stone, assistant works manager of Markham & Co., Ltd., Chesterfield, England, was awarded $1500, and a like amount was awarded Walter J. Brooking, director of testing and research, R. G. LeTourneau, Inc., Peoria, Ill., for his treatise on design, construction, features, and cost of making an arc-welded, wheel type, tractor transmission case and frame assembly.

In all, 408 awards were given to 458 participants representing practically every division of industry.

Renegotiation Law Denounced by Industry

The Northern Pump Co., Minneapolis, Minn., has published a 42-page booklet entitled "Dictatorship over United States Industry under Public Law 528." This is the so-called "Renegotiation Law," which gives the Army, Navy, and Maritime Commission the right to reduce prices on contracts already made, to reduce payments, or to demand refunds of payments made on work completed under contracts; briefly, power is conferred on these governmental authorities to abrogate Government contracts.

The booklet expresses the opinion of a great many of the leading industrial companies in this country with regard to the Renegotiation Law, which, obviously, destroys the confidence of manufacturers in the Government's intentions to play fair with industry. When Government agencies can abrogate Government contracts, the making of contracts with the Government becomes more or less of a farce. There are limits to which even Congress can go under our constitution. The constitutionality of this law has not yet been decided by our highest court.

* * *

By salvaging everything from out-dated rubber stamps to an obsolete power plant, the General Electric Co. will recover this year for war production 190,000 tons of waste material—enough to require 100 average freight trains for its transportation. At the present rate, the salvage department of the company will handle this year 5000 carloads of scrap.

Suggestion that Saved 22 Tons of Steel

Axel Johnson, a war worker at a New Jersey plant of the General Electric Co., recently suggested an improvement in the production of electrical equipment for cargo ships which saves approximately 22 tons of steel — enough metal to make 44,000 bayonets—in addition to saving 10 per cent of the operator's time in the plant. The suggestion brought Mr. Johnson the Award of Individual Production Merit granted by the War Production Board to employes who make unusual contributions to the war effort. He also received a check of $250 from the General Electric Co.

The suggestion consisted in a pattern change which reduced the weight of the brake wheels and enabled a greater number of them to be obtained from the same amount of metal. The saving in the operator's time is due to the fact that less machining is required on each wheel. These brake wheels are used in conjunction with motors which drive winches and other auxiliary equipment on board cargo ships.

* * *

Army-Navy Production Awards

Among the companies not previously mentioned in MACHINERY that have received the Army-Navy "E" Production Award for outstanding achievements in war production are the following:

- Aluminum Industries, Inc., Cincinnati, Ohio
- American Brake Shoe & Foundry Co., New York City
- American Machine & Metals, Inc., East Moline, Ill.
- American Rolling Mill Co., Middletown, Ohio
- Chain Belt Co., Milwaukee, Wis.
- Clayton Mfg. Co., Alhambra, Calif.
- Farrel-Birmingham Co., Inc., Ansonia, Conn.
- Hall-Scott Motor Car Co., Berkeley, Calif.
- Independent Pneumatic Tool Co., Aurora, Ill.
- Putnam Tool Co., Detroit, Mich.
- Revere Copper & Brass, Inc., New York City
- Veeder-Root, Inc., Hartford, Conn.
- N. A. Woodworth Co., Ferndale, Mich.

HOW REEVES HELPS SHARPEN ★ THE *Eagle's Claws*

. . . by Providing Production Machines with "Stepless" Speed Adjustability

The American eagle has already bared its claws, and used them with telling effect. Daily those claws are being sharpened—wings strengthened.

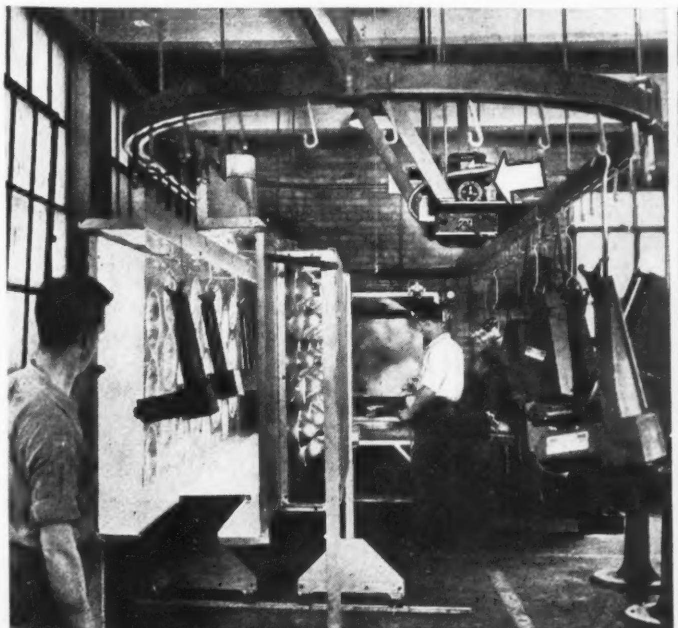
For America is not satisfied with building more planes, tanks, and guns than all our enemies put together. The planes must fly higher and faster, the tanks must deliver more devastating blows, the guns must shoot farther and harder.

And to achieve all of these results, REEVES Variable Speed Control for production machines is playing an important part—helping men and machines to produce maximum output by providing the right speed for each job and process; saving workers' time; saving materials and reducing the number of "rejects"; enabling new and unskilled workers to hit their stride in minimum time. Production increases from 25 to 50 per cent are not unusual.

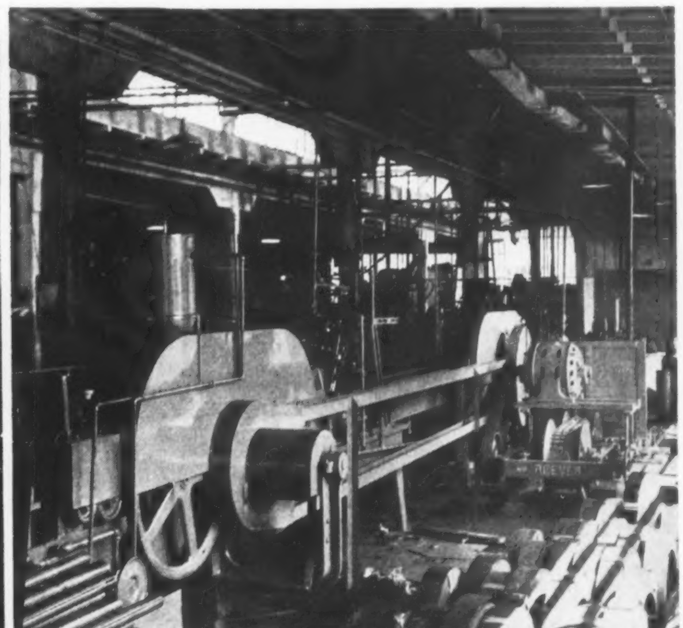
Write for booklet MG-423, "More Output for Victory," which illustrates and describes twenty-nine installations of REEVES Transmissions, Motodrives and Vari-Speed Motor Pulleys, with examples of increased productivity. We maintain a nation-wide staff of factory-trained speed control engineers. A member of this organization is located near you. *Shall we have him call?*

REEVES PULLEY COMPANY, COLUMBUS, INDIANA

REEVES Vari-Speed Motor Pulley regulates straight line production drying of industrial finishes by infra-red process—giving baked finish in any baking cycle from 8 to 18 minutes—a record-breaking time.



This tubing machine, driven through a REEVES Transmission, forms, welds, sizes and cuts to lengths up to 90 inches of tubing per minute—a four-way process that spits out airplane parts machine-gun style.



REEVES *Accurate Variable* **Speed Control**

Motion Picture to Stimulate Scrap Collection

The National Association of Manufacturers, with the approval of the Conservation Division of the War Production Board, has prepared and released an industrial film known as "Let's Get in the Scrap." The purpose of the film is to educate executive personnel on how to organize and successfully conduct a metal salvage campaign in the plant. The film is already being used by several hundred industrial plants, institutions, and associations. The twenty field offices of the Industrial Salvage Section of the War Production Board have copies of the film available for use in local scrap campaigns.

In preparing this film, due cognizance was taken of the fact that most industrial plants have, for years, collected certain kinds of scrap and chips from cutting operations. The new film is aimed to bring out the metal left in storerooms, partially fabricated parts, obsolete equipment, and odd metal scrap piles. The film emphasizes the importance of a nation-wide scrap campaign, since without scrap many war production plants would soon become idle.

Briefly, the essential rules in organizing a scrap campaign are: Appoint an executive in charge of the drive who has authority to carry out any decision of the salvage committee; prepare an inventory; and instruct foremen and plant personnel of the need for a scrap campaign and the necessity for everyone to cooperate. This rule is recommended for guidance: "If a machine or piece of equipment has not been used for three months, and you cannot prove that it is going to be used in the next three months—then find a use for it, or scrap it."

The film points out that the benefits of a successful salvage drive include a cleaner plant, with fewer accident risks, and the disposal of old equipment not now needed that may be replaced after the war with modern machinery.

Bullard Employes Present "Thunderbolt" Fighting Plane to the Air Force

Employes of the Bullard Co., Bridgeport, Conn., have presented to the U. S. Army Air Forces a Republic P-47 "Thunderbolt" fighting plane. As far as is known, the Bullard Co. is the first industrial plant in the nation, outside of the aviation industry itself, to contribute a plane to the armed forces.

The presentation took place, with proper ceremonies, on October 13, when the employes of the company, together with members of their families, attended a celebration which was broadcast from coast to coast over fifty stations of the Mutual Network.

The plane, known as the "Bullard Thunderbolt," flew over the Bullard plant during the ceremony. An inscription with the words "Presented to the Army Air Forces by the Employes of the Bullard Co." had been placed on the nose of the ship at the Republic plant, and will remain when the plane is shipped to the fighting front. The Bullard employes will be informed by the War Department at frequent intervals of the plane's achievements.

International Nickel Wins Navy Honor for the Third Time

The International Nickel Co.'s plant at Huntington, W. Va., has received its third war production award in the form of the right to fly the Army-Navy "E" with two stars. Previously, the works had received the Naval Ordnance Award, followed later by renewal in the form of the Navy "E" Award with one star. The plant is among the first twenty-five throughout the nation, and the first in the Fifth Naval District, to win the Army-Navy two-starred "E" pennant. Each star represents the renewal of production excellency for a six months' period. The original award was for a twelve-month period.

G. A. Gray Co. Receives Army-Navy "E"

The G. A. Gray Co., planer builders of Cincinnati, Ohio, recently received the Army-Navy "E" award. The presentation was made by Rear Admiral William C. Watts of the United States Navy. After paying tribute to the three years' struggle of the British and to the gallant stand of the Russians, Admiral Watts said: "We should all realize that our nine months of war is hardly a taste, either as to length or degree of sacrifice, of what we must be prepared to face if this war is to be brought to that conclusion which I believe would alone be acceptable to you all."

Erwin Marx, works manager, accepted the "E" pennant on behalf of Henry Marx, president, and the employes of the company. Major Carl W. Rich, representing the Army, presented the employe emblems to Ben Rich, who accepted them for the employes.

Mr. Marx referred to the fact that his company makes the planers that are used in many other machine tool factories, so that actually the men in the Gray plant make the machines that make other machines that make war supplies.

* * *

Carboloy Design Standards

In order to eliminate a vast amount of special tool designing on the part of carbide tool users, as well as to speed deliveries of many formerly special tools, the Carboloy Company, Inc., Detroit, Mich., has adopted a series of design standards. By the use of these standards, the time normally required for preparing special design drawings, figuring quotations, preparing working drawings, and hand-forming of special samples is eliminated.

The new standards, while not carried in stock at present, have been evolved as a result of intensive study of special tool orders received by the company in connection with the production of war materials. It is expected, if demand warrants, that many of the new design standards will eventually be added to the great variety of tools already carried in stock by the company for immediate delivery. The new design standards include cut-off tools, roller turner tools, grooving tools, shear tools, and twist drill tips.

NEWS OF THE INDUSTRY

California

WHITNEY C. COLLINS has been appointed vice-president in charge of sales policy of the Elastic Stop Nut Corporation, Union, N. J. Mr. Collins has been a director of the company since 1940. He is head of the Collins-Powell Co., Beverly Hills, Calif., representative of the Elastic Stop Nut Corporation.

Illinois

RUSSELL G. DAVIS was elected vice-president of the Foote Bros. Gear & Machine Corporation, Chicago, Ill., at a recent meeting of the board of directors. Mr. Davis will continue in his capacity as general manager of the Industrial Gear Division.

Russell G. Davis, New Vice-president of Foote Bros. Gear & Machine Corp.

HOWARD D. GRANT has been elected president of the Whiting Corporation, Harvey, Ill., manufacturer of overhead traveling cranes, rotary shears, aviation equipment, foundry equipment, and other heavy machinery, and STEVENS H. HAMMOND has been made executive vice-president. Mr. Hammond will also serve as chief of the executive staff. R. ELLIOTT MAXWELL has also been appointed a vice-president of the company. He will make his headquarters in the New York office at 136 Liberty St., and will supervise the sales force in the eastern half of the country. D. POLDERMAN, JR., formerly sales manager of the New York-Philadelphia district, has been made a member of the executive committee.

HAROLD A. WILSON, former sales representative for the Drive-All Mfg. Co., Chicago, Ill., has recently been advanced to the position of manager of the Chicago district. He succeeds J. RALPH GRIFFITH, who has been made general sales manager for the factory and home office of the company in Detroit. The Chicago office of the company is located at 30 N. LaSalle St.

INDEPENDENT PNEUMATIC TOOL CO., 600 W. Jackson Blvd., Chicago, Ill., announces that its Boston office has been moved to 78 Brookline Ave., and its Birmingham, Ala., office to 1411 N. Third Ave. VANCE G. TURNER has been appointed branch manager at Boston.

Michigan

SALVO TOOL & ENGINEERING CO. is a new concern established at 26441 Gratiot Ave. in Roseville, Mich., by EDWARD A. SCHMIDT and LEO BEDKER. The new concern is engaged in manufacturing tools, jigs, fixtures, dies, and special equipment. Mr. Schmidt was connected for eighteen years with the Zenith Carburetor Division of the Bendix Aviation Corporation. Mr. Bedker has had twenty years of tool work experience, and was formerly associated with the Hudson Motor Co.'s Naval Ordnance engineering department.

W. T. CUSHING has been made Detroit branch manager of the Bay State Abrasive Products Co., Westboro, Mass. Mr. Cushing has had twenty-five years of sales experience in the grinding wheel business, the greater part of which time was spent in Michigan. The Detroit office of the Bay State Abrasive Products Co. is located at 105 Baltimore Ave. East.

A. O. THALACKER has been appointed general manager of the Detroit Rex Products Co., Detroit, Mich., manufacturer of metal-cleaning equipment. Mr. Thalacker has been a company executive for the last five years, and lately has been secretary, a position he will still hold.

HERBERT C. ROUSHKOLB, district sales manager for the Cleveland Automatic Machine Co. in Detroit for twenty-five years, is now operating his own plant at 1425 Birwood Ave., Detroit, which is engaged in rebuilding automatic screw machines.

A. J. MILLER, who has been connected with the Detroit office of the Norton Co., Worcester, Mass., for a number of years, has been appointed field engineer for that territory.

New England

HERBERT J. BURGESS has been appointed general superintendent in charge of all manufacturing at the East Springfield, Mass., plant of the Westinghouse Electric & Mfg. Co.

THOMAS O. ARMSTRONG has been appointed manager of the industrial relations department of the Westinghouse Electric & Mfg. Co.'s East Springfield, Mass., plant.

FRED C. TANNER, vice-president and formerly manager of engineering sales of the Federal Products Corporation, Providence, R. I., has been advanced to the position of general manager. Mr. Tanner was at one time development engineer on new inspection, quality control, and production for the Western Electric Co. in Chicago and later was chief inspector of radio and general manufacturing with the General Electric Co. at Bridgeport, Conn.

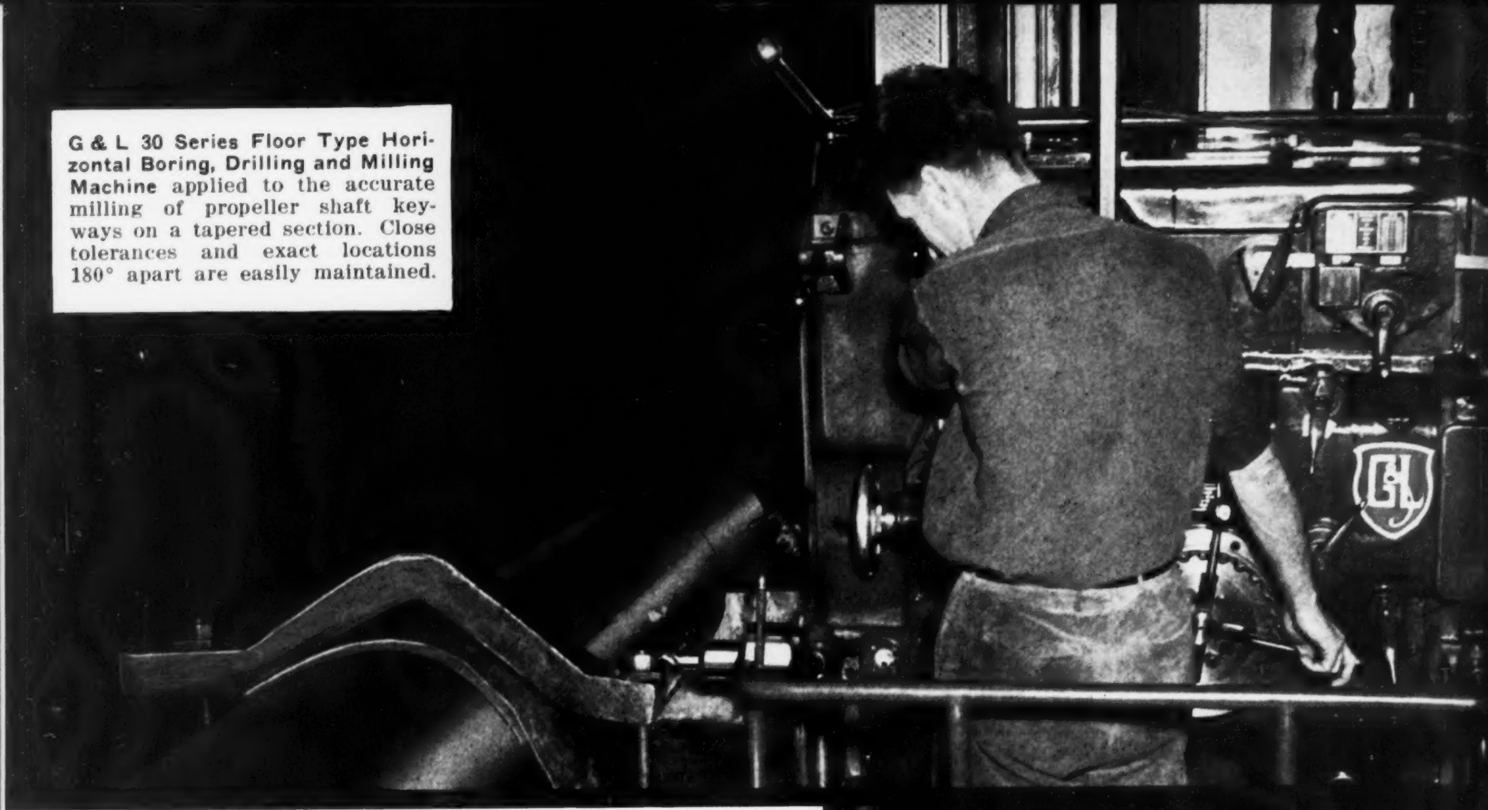
WALTER J. WOHLENBERG, professor of mechanical engineering, Yale University, New Haven, Conn., has been elected a vice-president of the American Society of Mechanical Engineers to serve for two years.

New Jersey and New York

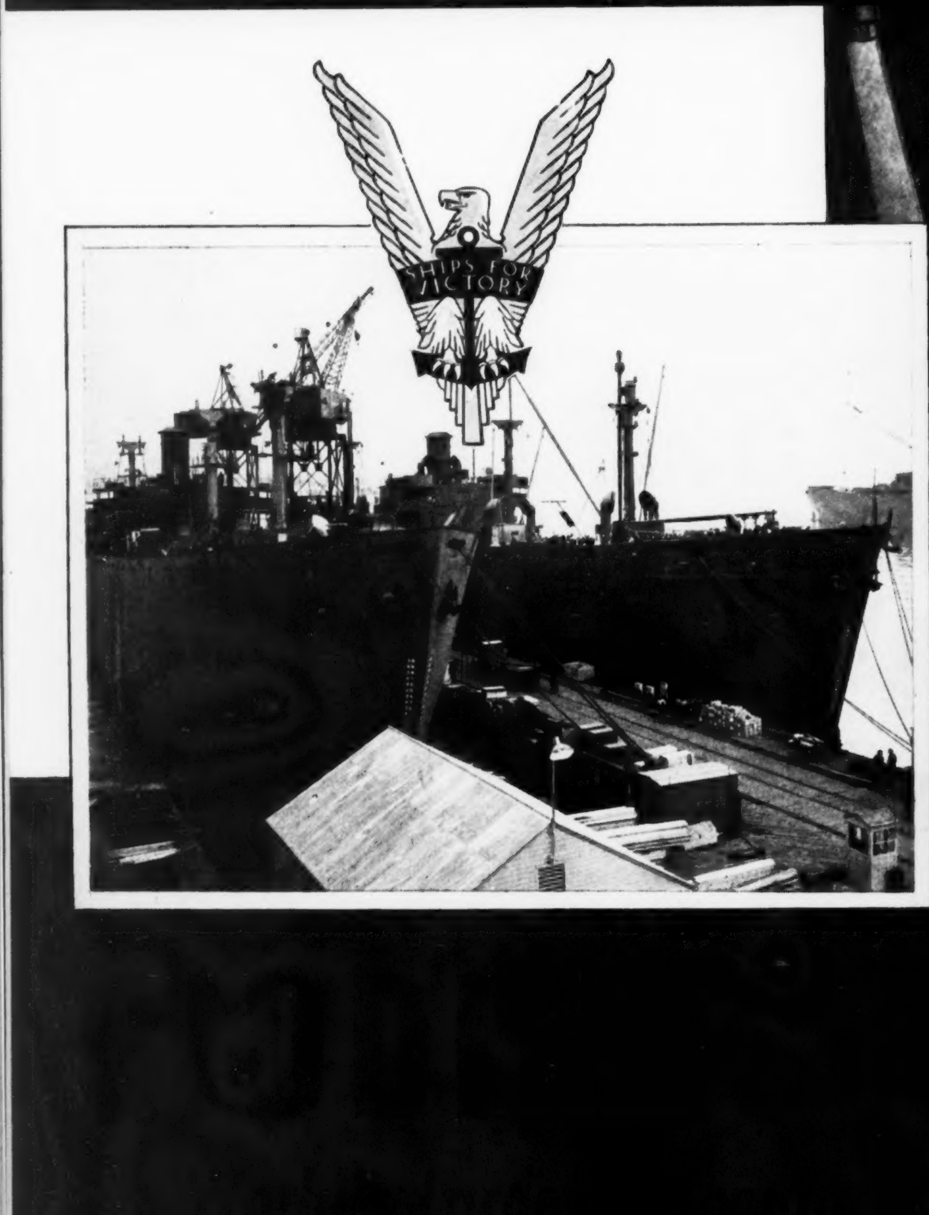
AIRCRAFT PARTS DEVELOPMENT CORPORATION is a new concern with offices, laboratories, and shops in Summit, N. J., organized to handle research and development work on parts and materials for the aircraft industry, especially in the fields of fastening devices, powdered metals, and plastics. The activity of the concern will extend to the designing and tooling of any special machinery required for the manufacture of products evolved.

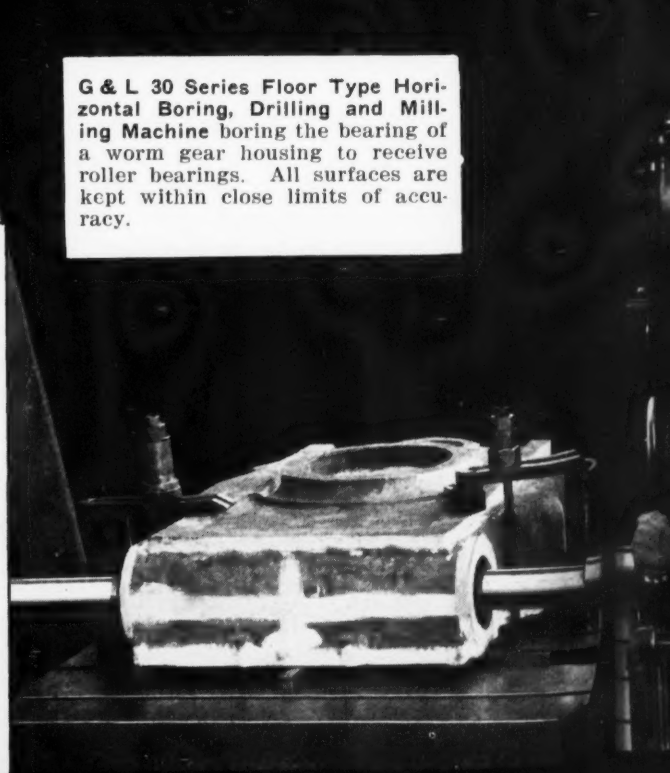
H. L. WATSON, since 1934 executive vice-president and director of the DeLaval Steam Turbine Co., Trenton, N. J., has been elected president of the company, succeeding FRANCIS J. AREND, who died last August.

BLANCHARD MACHINE CO., 64 State St., Cambridge, Mass., has appointed the RUDEL MACHINERY CO., INC., with offices in New York City and Hartford, Conn., representative of the company



G & L 30 Series Floor Type Horizontal Boring, Drilling and Milling Machine applied to the accurate milling of propeller shaft keyways on a tapered section. Close tolerances and exact locations 180° apart are easily maintained.

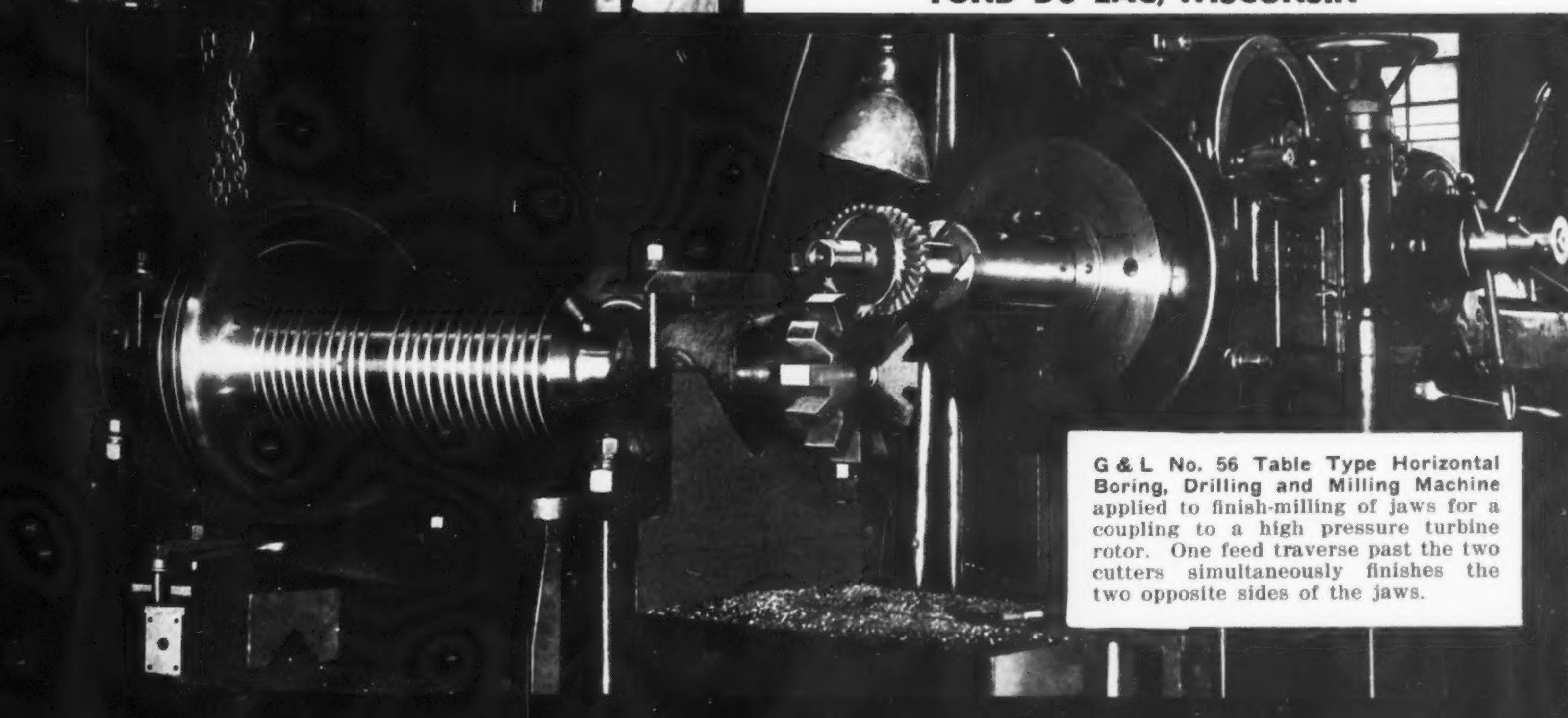




G & L 30 Series Floor Type Horizontal Boring, Drilling and Milling Machine boring the bearing of a worm gear housing to receive roller bearings. All surfaces are kept within close limits of accuracy.

G & L High Power Precision Horizontal Boring, Drilling and Milling Machines are ideally designed for today's heavy-duty, precision operations in modern shipbuilding practice. Evidence of their successful application and suitability for this class of work appears in these three action photographs and their descriptions, which illustrate typical G & L Shipbuilding jobs on Marine Engine parts. Work of this sort calls for the ultra-precision and versatility in which G & L Machines excel. They permit convenient and fast changeovers from "special" to "production" operations...a range which includes accurate small jobs as well as accurate big jobs . . . they save untold man-hours by avoiding extra setups on planer, miller and radial . . . they guarantee extreme rigidity for heavy-duty work . . . insure close limits of accuracy for high production. Inquiries are solicited, and engineering recommendations will be sent without obligation.

THE GIDDINGS & LEWIS
MACHINE TOOL COMPANY
FOND DU LAC, WISCONSIN



G & L No. 56 Table Type Horizontal Boring, Drilling and Milling Machine applied to finish-milling of jaws for a coupling to a high pressure turbine rotor. One feed traverse past the two cutters simultaneously finishes the two opposite sides of the jaws.

in the eastern part of New York State, northern New Jersey and the entire state of Connecticut.

Ohio

ROBERT C. SESSIONS, of the consulting engineering firm of Sessions & Sessions, Cleveland, Ohio, has been appointed chief engineer of the Brown Fintube Co., Elyria, Ohio. The firm of Sessions & Sessions is being continued, with offices in the Rockefeller Building, Cleveland, Ohio, under the active direction of Frank L. Sessions, senior partner of the firm. Before entering consulting work, Robert Sessions was for some time in charge of the engineering and experimental division of Steel & Tubes, Inc. He is a member of the A.S.M.E. and the A.I.E.E.

Robert C. Sessions, Newly Appointed Chief Engineer of the Brown Fintube Co.

WILLIAM J. SAMPSON, JR., formerly general manager of sales for the Steel and Tubes Division of the Republic Steel Corporation, Cleveland, Ohio, has been made president of the American Welding & Mfg. Co., Warren, Ohio. Mr. Sampson succeeds Howard J. Kaighin, who was killed recently in an automobile accident.

RELIANCE ELECTRIC & ENGINEERING CO., Cleveland, Ohio, has leased the plant at present occupied by the Stoker Division of the Pocahontas Fuel Co. These additional motor manufacturing facilities will be operated separately as the Marine Division.

D. L. IMMEL has been promoted to the position of assistant plant superintendent at the Warren, Ohio, plant of the Copperweld Steel Co.

Pennsylvania

W. A. SCHLEGEL, of the metallurgical department, Carpenter Steel Co., Reading, Pa., has been awarded the Henry Marion Howe Gold Medal by the American Society for Metals for his paper on "Surface Carbon Chemistry and Grain Size of 18-4-1 High-Speed Steel." The award was made at the recent Cleveland meeting of the Society. Mr. Schlegel has been with the Carpenter Steel Co. since his graduation from college in 1927.

HENRY A. ROEMER, JR., formerly manager of sales of steel and wire products for the Pittsburgh Steel Co., Pittsburgh, Pa., has been advanced to the position of assistant general manager of sales, and NORMAN F. MELVILLE, formerly assistant manager of sales of steel and wire products, has been made manager of sales of that department.

JOSEPH DEJURE has been appointed representative of the American Swiss File & Tool Co. in eastern Pennsylvania, southern New Jersey, Delaware, Maryland, and the District of Columbia. Mr. DeJure's headquarters are at 410 Commerce St., Philadelphia, Pa.

HARRY F. BOE, manager of the district repair and manufacturing department of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and H. V. PUTMAN, manager of the company's transformer division, have been elected to the rank of vice-president by the board of directors.

Washington, D. C., and Kentucky

GEORGE L. SEXTON, of the Automatic Machinery Mfg. Corporation, Bridgeport, Conn., manufacturer of machine tools, has recently sold all the capital stock of his company to National Fireworks, Inc., of West Hanover, Mass., and has resigned as president and general manager. Mr. Sexton has taken a lease on a suite in the Defense Building, 1026 Seventeenth St., Northwest, Washington, D. C., from which address he will operate a business consulting service.

CLARENCE E. SHIPLET, superintendent of erection and machinery at the Louisville Division of the Westinghouse Electric & Mfg. Co., has been awarded the Westinghouse Order of Merit for distinguished service. The award was presented to Mr. Shiplet "for his ability to organize relatively unskilled workers into a trained and enthusiastic team capable of assembling equipment of extreme accuracy of workmanship; for his technical ability and judgment in handling difficult factory problems; and for his devotion to the interests of the company."

OBITUARIES

Edward H. Thomas

Edward H. Thomas, manager of the New York office of the Farrel-Birmingham Co., Ansonia, Conn., died at the Presbyterian Hospital in Pittsburgh on September 13, following a heart attack. Mr. Thomas was born in New York City on July 1, 1886. He received his early education in the public schools of East Orange, N. J., and was graduated from Stevens Institute of Technology with the degree of Mechanical Engineer. After graduation, he was engaged in the design, erection, and operation of sugar factories in the West Indies and in the Philippine Islands. Upon his return from the Philippines he continued in the engineering profession in New York City, and in March, 1926, became affiliated with the Farrel-Birmingham Co. as sales engineer and manager of the company's New York office.

During the first World War he served in the Ordnance Department, supervising the manufacture of TNT. In the years of the country's maritime expansion preceding and during the present World War, he was active in the sale and installation of gear drives in many types of commercial and Maritime Commission ships.

Of a genial and helpful disposition, he was highly esteemed for his personal qualities, as well as for his professional ability, and his passing is deeply regretted by his many friends.

ROY HUNTER, direct sales representative in the northern Ohio and western Pennsylvania area for the Gisholt Machine Co., Madison, Wis., died on September 12 at the age of fifty-four. Mr. Hunter had been identified with the machine tool industry for years, including a long association with the International Machine Tool Co. prior to his connection with the Gisholt field sales personnel two and a half years ago.

WILBUR L. GOURLEY, president of the Lehmann Machine Co., St. Louis, Mo., died on September 19.

* * *

In ordering small tools such as taps, milling cutters, drills, etc., especially when the use of these tools is in any way out of the ordinary, the manufacturer of the tools should be told what the tools are to be used for and how it is planned to operate them. This will enable the tool manufacturer to recommend the best type of tool available for the work to be done.

NEW BOOKS AND PUBLICATIONS

HANDBOOK OF SHIP CALCULATIONS, CONSTRUCTION, AND OPERATION. By Charles H. Hughes. 558 pages, 5 by 7 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York City. Price, $5.

This is the third edition of a handbook for marine engineers, ship and engine draftsmen, deck officers, and others engaged in the building and operating of ships. Theoretical calculations have purposely been omitted. The text has been revised and rewritten to include changes that have taken place in shipbuilding since the previous edition was published. There are ten sections covering the following subjects: Weights, Measures, and Formulas; Strength of Materials; Shipbuilding Materials; Ship Calculations; Hull Construction; Machinery; Electricity; Heating, Ventilation, Refrigeration, Air-Conditioning, Bilge, Ballast, Sanitary, and Fire Protection Systems; Ship Equipment; and Ship Operation.

THE STEAM LOCOMOTIVE. By Ralph P. Johnson. 502 pages, 6 by 9 1/4 inches. Published by the Simmons-Boardman Publishing Co., 30 Church St., New York City. Price, $3.50.

This book has been written to fill the need for a modern work on the theory, operation, and economics of the steam locomotive. It covers the subject from the standpoint of recent research and current practice. Comparisons with Diesel electric locomotives are included. The book should be of value to engineers, locomotive designers, superintendents of motive power, locomotive shop superintendents, master mechanics, and others concerned with motive power work. Students in the growing courses in transportation will find this book a useful text on modern locomotive practice.

ARC WELDING. 103 pages, 8 1/2 by 11 inches. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Price, $1.25.

This book is a recent addition to the job training units prepared and tested by the staff of the Dunwoody Industrial Institute. It is the first of two manuals on training in welding, and deals with arc welding. The second book deals with oxy-acetylene welding. The arrangement of the book is the same as in previous training units, a job sheet, an information sheet, and check-up questions being provided for each job. This manual provides training on forty arc-welding jobs. The equipment required, general instructions, and operating steps are given in each case.

METHODS OF MEASUREMENT. By Wendell H. Cornetet. 132 pages, 6 1/2 by 10 inches. Published by McKnight & McKnight, 109 W. Market St., Bloomington, Ill. Price, 80 cents.

This work is the first of a series of five books prepared with the object of improving the instructional material used in teaching related science to vocational students. The present book gives the student information on the various methods of measurement used in industry, and the tools employed. Exercises are provided for each type of tool to train the student to make accurate and exact measurements. Instructions are also given on measuring properties of materials, such as temperature, specific gravity, and tensile strength.

MOGUL METALLIZER PROCESS MANUAL. 64 pages, 6 by 8 1/2 inches. Published by the Metallizing Co. of America, 1330 W. Congress St., Chicago, Ill. Price, $2.

This manual has been prepared to assist users of metallizing equipment in the proper operation of metal spray guns. It describes how to prepare the surface for metallizing, how to apply the coat, procedure in finishing, protective appliances, machine element coatings, machining the coating, and metallizing wires and their uses.

CODE OF MINIMUM REQUIREMENTS FOR INSTRUCTION OF WELDING OPERATORS (Part A — Arc Welding of Steel 3/16 to 3/4 Inch Thick). 68 pages, 6 by 9 inches. Published by the American Welding Society, 33 W. 39th St., New York City. Price, 50 cents.

* * *

Jones & Lamson Completes 1000th Thread Grinder

The 1000th automatic thread grinder built in the plant of the Jones & Lamson Machine Co., Springfield, Vt., was recently shipped by the company. The event is interesting because it justifies the belief of the officials of the company for many years that precision thread grinding would become valuable as a production process, competing not only in accuracy, but in speed, with other methods of producing screw threads.

Training Carbide-Tool Specialists

Over 200 carbide tool specialists—known as "carbide supervisors"—were trained for about 100 large industrial concerns during the first six months of 1942 in the training school operated by the Carboloy Company at its Detroit plant. This school gives advanced training to men who will have complete responsibility in a plant for all work relating to the design, application, and care of carbide cutting tools.

The course is concentrated into one week of intensive training. The classes consist of twelve men. The instruction requires the full time of one engineer qualified in carbide applications and three assistants. The men trained in this course are equipped to conduct, upon return to their own plants, further training courses in the design, application, and care of carbide tools. There is no charge for this course.

COMING EVENTS

NOVEMBER 10-11 — WAR PRODUCTION CONFERENCE OF THE AMERICAN MANAGEMENT ASSOCIATION at the Hotel New Yorker, New York City. For further information, address American Management Association, 330 W. 42nd St., New York City.

NOVEMBER 24 - 29 — NATIONAL CHEMICAL EXPOSITION AND INDUSTRIAL CHEMICAL CONFERENCE at the Sherman Hotel, Chicago, Ill. For further information, address National Chemical Exposition, 110 N. Franklin St., Chicago, Ill.

NOVEMBER 30 - DECEMBER 3 — Annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at the Hotel Astor, New York City, Secretary, C. E. Davies, 29 W. 39th St., New York City.

NOVEMBER 30-DECEMBER 4 — Fifteenth NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING at Madison Square Garden, New York. Charles F. Roth, manager, International Exposition Co., 480 Lexington Ave., New York City.

DECEMBER 2-4—WAR CONGRESS OF AMERICAN INDUSTRY at the Waldorf-Astoria Hotel, New York, under the auspices of the National Association of Manufacturers, with general offices at 14 W. 49th St., New York.

JANUARY 11-15, 1943 — Annual meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Book Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary, 29 W. 39th St., New York.

... it's an old story at Genesee

Long before limitations were placed on the use of High Speed Steel (18-4-1), the makers of "Tomahawk" tools were already regularly producing cutting tools made up of H.S.S. tips on soft steel shanks.

Such "Tomahawk" tools were being used in regular production by one of the largest automobile manufacturers, for instance, as far back as 1938.

Production quantities were not large—in those days there was no tungsten shortage—but it did provide Genesee with the essential production background to produce such tools when suddenly needed in quantities.

That has been and will continue to be one of Genesee's policies:— to be ready with new forms of "Tomahawk" quality tools, standard or special, for any set of conditions, — for war or for the peace to follow.

We will be glad to send you a condensed catalog of "Tomahawk" tools, streamlined to present conditions. Ask for Catalog No. GT-42-M.

GENESEE TOOL COMPANY

FENTON, MICHIGAN

★ Registered Trade Mark

Classified Contents of this Number

Your Progress Depends Upon Your Knowledge of Your Industry